SCIENTIFIC AMERICAN

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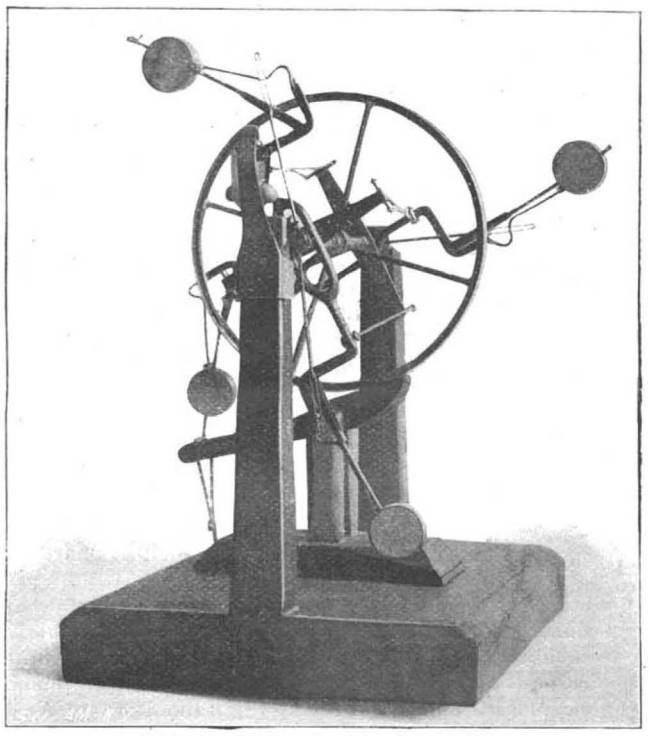
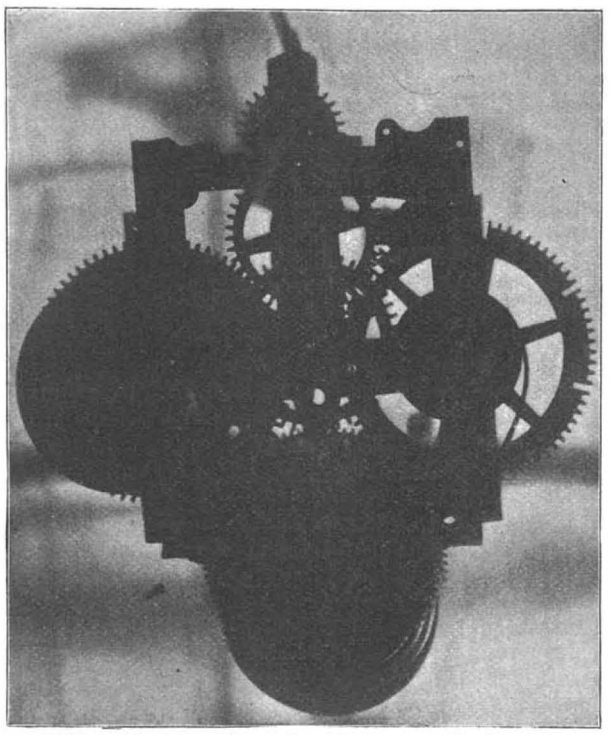
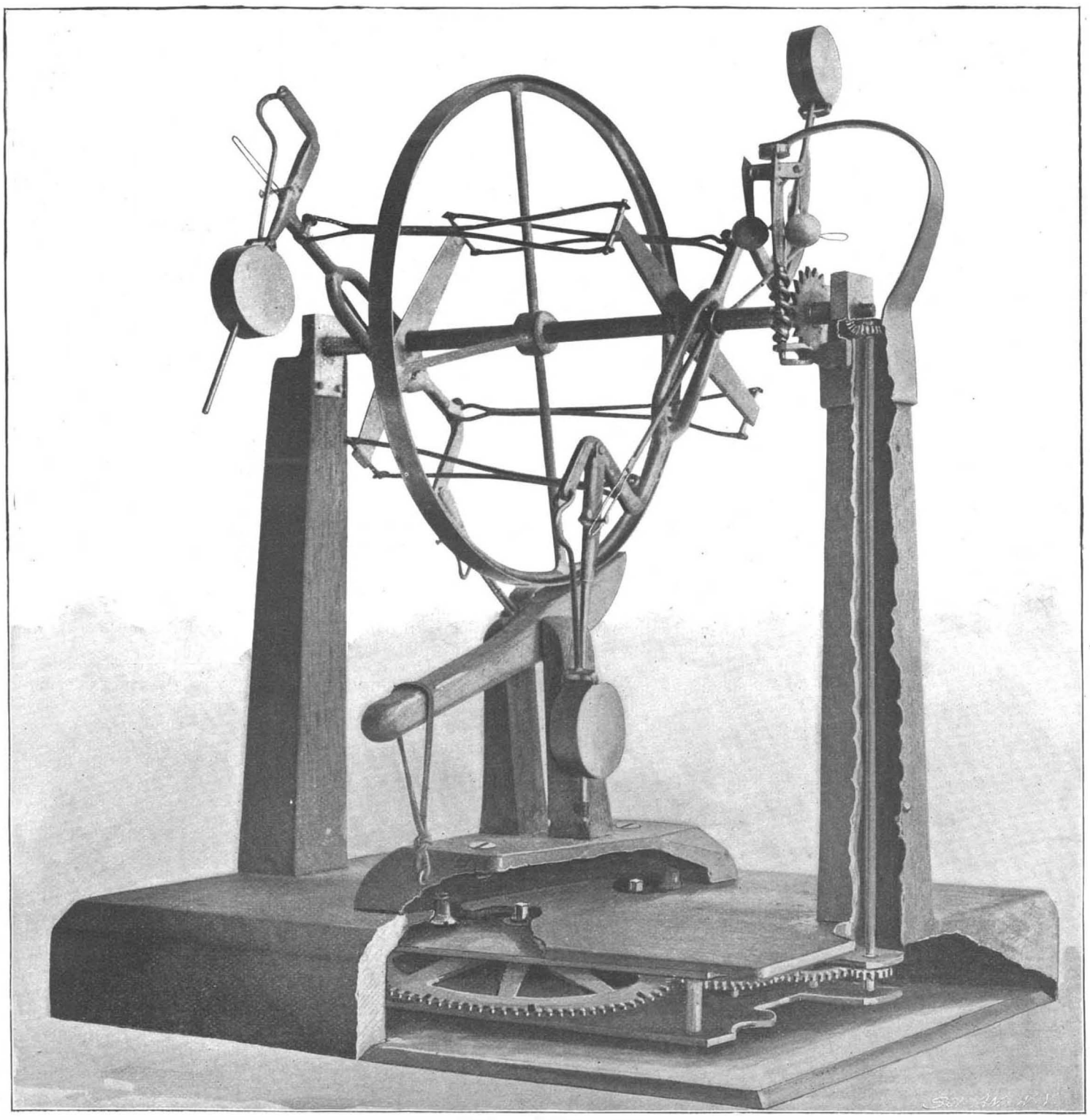


Motor as it Looked to the Public.



X-Ray Photograph of the Concealed Clockwork.



Motor as Actually Made.

TYPICAL PERPETUAL MOTION FRAUD.—[See page 9.]

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A PERTINENT QUESTION.

It is generally understood that the main object of Congress in authorizing the President to appoint a new canal commission was to secure an impartial investigation of the relative advantages of the Nicaragua and Panama routes. The many commissions which have examined and reported on the feasibility of these two locations include the names of four Americans of more or less professional reputation, two of whom, Admiral Walker and Prof. Haupt, have pronounced themselves as being heartily in favor of the construction of the Nicaragua Canal, while the other two, General Abbot and Mr. Fteley, have indorsed the Panama route. In making up the new and presumably non-partisan commission, the President has included Admiral Walker and Prof. Haupt and ignored General Abbot and Mr. Fteley, who are, by the way, two of the most distinguished hydraulic engineers in America, and pre-eminently qualified to serve on a purely technical commission such as this. Why has this partisan selection been made?

If the Executive is desirous of learning the exact truth regarding the Panama scheme, why has there been omitted from the Commission the very experts who alone are able to give the fullest and most reliable information? The work of General Abbot in connection with the army engineers has won for him a world-wide reputation, and Mr. Fteley, who is a past president of the American Society of Civil Engineers, is now engaged in the construction of the great Croton dam, the most formidable undertaking of its kind in the world. These two gentlemen are so obviously fitted to take a prominent part in the work of the new Commission that their exclusion is liable to arouse serious doubts and misgivings in the minds of that portion of the public which is familiar with the isthmian canal situation, as to the bona fide nature of the investigation.

SPEED AND AIR RESISTANCE IN CYCLING.

It is pretty well understood among those wheelmen who have given any thought to the subject that the chief element of resistance in riding the bicycle on level roads is due to the atmosphere. The simplest proof of this is to be found on a windy day, when the difference between riding against and riding before the wind has only to be felt to be appreciated. The remarkable feat of the professional cyclist Murphy, who on June 21 rode a mile behind a locomotive in one minute and five seconds, proves what an extraordinarily large proportion of the effort of the rider is expended in overcoming air resistance. The shortest time in which a mile has ever been covered with a flying start, unpaced, is one minute, fifty-five and four-fifths seconds. This was done by the rider Hamilton at Denver, June 18, 1898. With human pacing, where the rider is partially protected from the rush of air, the fastest time has been made by Taylor, who covered the mile in one minute and thirty-one and four-fifths seconds. In the recent trial provision was made for inclosing the rider in front, above, and on both sides by a wind shield, and making this protection so complete that he was riding practically in still air. The result shows that complete protection from the wind enables a rider to increase his speed by about 100 per cent. Comparing their records, it is questionable whether Murphy could ride a mile unpaced in as short a time as Hamilton; or to put it in other words, it is probable that Hamilton could ride a mile under the Murphy conditions in less than one minute.

From a scientific standpoint this extraordinary feat will have a value as attracting further attention to the serious nature of air resistance, for it raises the question as to whether the form of all vehicles that move at high speed should not be modified so as to present the least possible resistance to the wind. This is particularly true of locomotives and cars, and it is conceivable that some light form of sheathing extending from the cars nearly to the rails, and from car to car, might materially aid in reducing the air resistance.

A FALSE ALARM.

Several of the New York dailies recently published a rather lurid description of the danger which attends our recently purchased cruiser, the "New Orleans," whenever she goes to sea. The public was gravely informed that this vessel and her sister ship, the "Albany," which is now completing at the Elswick Works, England, have so little natural stability that under certain conditions of loading they are liable to "turn turtle" and disappear from the active list of the United States navy. As a matter of fact, there is not a word of truth in the rumor, and the "New Orleans" merits all the words of commendation which have been bestowed upon her by the officers who were in charge of this crack vessel during the operations of the Spanish war. The origin of the rumor is to be traced to the misunderstanding of a report which was recently made by Naval Constructor Bowles on the inclining experiments lately carried out upon this vessel. Every ship that is built for the United States navy, or acquired by purchase, is put through a series of tests to determine her stability under widely varying conditions of loading. Although the elements of stability are carefully calculated when a ship is designed, there is always a possibility of subsequent changes in the armament or construction of the vessel causing slight variations from the intended stability, and hence it is the practice in our navy to ascertain the actual stability by inclining tests made after the ship is afloat. In the case of the "New Orleans" this was done at the earliest convenient opportunity after the war, and the results were tabulated and forwarded in a report to Washington. It was a misconstruction of the meaning of the report which led to the ridiculous statements which have been referred to above.

To determine the stability when she is absolutely light, the "New Orleans" was emptied of all coal, ammunition and stores, a condition, of course, in which she would never be found when in commission. It was discovered that when absolutely empty, she has what is known as a negative metacentric height, and in this condition she inclines to port or starboard a few degrees until she assumes a position of stability. There is in this nothing unexpected or unprovided for in her design. Indeed, it is a fact that all the great transatlantic liners have a negative metacentric height when empty of coal and stores, and provision is made in them, as it is in the "New Orleans," for taking a sufficient amount of water as ballast into the double bottom to restore the vessel to an even keel.

It is true that as compared with the majority of our home-built warships the "New Orleans" has, when light, less stability. This results from the fact that more attention is paid in our ships to certain elements which are neglected in the Armstrong vessels in favor of coal capacity, speed, stores and armament. In our own ships, and in those of the British navy, liberal provision is made for the comfortable berthing of the crew. More space is given up to their accommodation than is allowed in the ships of foreign navies. The Armstrong Company, which built the "New Orleans," has a reputation for turning out warships of high speed, great coal capacity and unusually heavy armament, and there is no denying the fact that their ships are particularly showy in this respect. In the elements which do not appear upon paper, however, but which are of equal importance, their vessels will be found in many cases to be lamentably lacking. As a rule, the crew and officers are the chief sufferers, as, for instance, on the "New Orleans," where a large part of the space on the berth deck, which in American ships would be utilized completely as living and sleeping quarters for the crew, is taken up by coal bunkers, something which would never be allowed for a moment by our Bureau of Construction and Repair. Then, again, the number of rounds of ammunition carried per gun is small in these ships; there is a scarcity of small boats; ventilation is not so thoroughly worked out, and in various respects weight is saved in order that it may be put into guns and motive power. Now, when a vessel of this type begins to be emptied of her coal, stores and ammunition—weights which are carried low down in the hull of a ship—it will be seen that she quickly loses her stability and the metacentric height is liable to change from the positive to the negative.

The "New Orleans" incident is of considerable interest as showing how easily we may fall into error in judging of the value of one particular warship as against another. There has been a continual outcry raised in England against the latest ships designed for the British navy by Dr. White, Chief Naval Constructor, because these vessels as compared with the Armstrong vessels have shown ton for ton of displacement a great inferiority in certain elements of fighting power. They are not nearly so heavily armed; they are not so fast; they are not even so well protected; yet, as a matter of fact, we have no doubt that Dr. White, who is responsible for their design, could show that they have compensating advantages in the way of roominess, sea-worthiness, large supplies of ammunition and ample stores which make them fully the equal of the Armstrong ships.

Without saying anything derogatory of the splendid vessels which are turned out from the Elswick yards, the matter may be expressed in a nutshell by saying that Armstrong builds for the trade and with an eye to the grandstand, and while such phenomenal vessels as the "O'Higgins" and "Esmeralda" are vastly more powerful in armament and speed than other vessels of a like displacement, it is not likely that in the test of actual warfare they would be found to be either better or worse than the best of other navies.

SCIENCE AND SPIRITUALISM.

We have recently been entertained by the daily press with accounts of a spiritualistic investigation of the immortality of the soul, which is remarkable, not so much for the novelty of the results obtained, as for the prominent position occupied by the chief inquisitor as a professor in one of our foremost institutions of learning.

That Prof. Hyslop believes that he has found in spiritualism additional and complete proofs of the soul's immortality can hardly be questioned. He states that he has arrived at his conclusions only after a most thorough and painstaking examination, in which all possibility of fraud was carefully excluded. Indeed, it is the very method of investigation employed which Prof. Hyslop so strongly emphasizes; for he lays great stress upon the scientific methods, the care, and exhaustiveness which characterize his inquiry and distinguish it from previous work in this direction.

Prof. Hyslop has asked the public to withhold its judgment until he has published a full account of his experiments and submitted the facts which he has gathered to the scientific world. As a matter of mere courtesy and justice we should wait. But in the meantime we cannot help remarking how puerile and fruitless have been the results of previous attempts, how disproportionate the time and effort expended. Such men as Marsh, Kebble, Dr. Hodgson and Prof. James have also attempted a scientific investigation of spiritualistic phenomena. Mr. Marsh, we are told, talked with Adam and Eve, with Methusaleh and other biblical personages. Mr. Kebble conversed with Washington, Bonaparte, Byron and a host of equally distinguished men, and both Hodgson and James have brought all the undoubted critical acumen of their minds to bear upon the case of Mrs. Piper. The actual results, judged from a dispassionate, scientific standpoint, are very disappointing. Even in the case of Hodgson and James, they are vague, trivial and inconclusive.

The many newspaper articles which have appeared on Prof. Hyslop's experiments give us (chiefly because of his reticence) no coherent account of what he has actually accomplished. From the little that can be gleaned, however, we are not very sanguine that anything new has been added to what is already known of spiritualism.

In his spiritualistic experiments, Prof. Hyslop has been associated with some of the most distinguished psychologists and alienists, men who have become well known through the value of their contributions to mental science. For this reason we have a right to expect something more than the vagueness and ambiguity which have ever been characteristic of spiritualism, something which will at least prove amenable to the ordinary laws of evidence, and afford us that sensible proof of immortality, the desire for which is coeval with the existence of the human race. Although the publication of the results of his examination into spiritualism may not be accompanied by "such a wave of excitement as the world has never seen before," we trust Prof. Hyslop will keep his promise, and if he presents us with results in the way of spirit communication, we hope they will be marked by that dignity and practical utility which have been so invariably and conspicuously wanting in all previous communications.

THE TRANSPLANTATION OF NERVES.

In a certain proportion of injuries to nerves, the ends cannot be brought together, and a portion of the nerve obtained from one of the lower animals or from an amputated limb can be implanted. Dr. R. Peterson has contributed an important article to The American Journal of Medical Sciences on the transplantation of nerves. It gives some interesting instances. In one case a man was severely injured in the right wrist by a circular saw; he lost sensibility in the hand. Five months after the injury the transplantation of a nerve was decided upon. Four centimeters of the sciatic nerve of a young bloodhound was sutured between the ends of the median nerve with kangaroo tendon. A similar operation was performed on the ulnar nerve. On the following day a distinct return of sensibility in the thumb was found; three months after the operation, sensibility was almost complete. There are twenty recorded cases of transplantation of nerves. There were eight primary and twelve secondary operations. The time from the injury to the operation varied from forty-eight hours to one and a quarter years. Eight out of twelve cases of the secondary operation showed improvement in sensibility or motion, while only four out of eight cases of primary operation im-

proved. The interval between the ends of the divided nerves varied from three to ten centimeters; but the distance did not seem to affect the result.

In nine cases the transplanted parts were from the sciatic nerves of dogs, three from rabbits, one from a kitten, and one from the spinal cord of a rabbit, and in five from recently amputated limbs. In one case a sciatic nerve which had been excised was itself transplanted. In nine cases catgut was used to unite the implanted segments of divided ends; in three, silk; and in one, kangaroo tendon. No case recovered entirely, but generally the cases were very much improved. The average time in which sensibility appeared after the operation was about ten days, and motion returned in two and half months.

PREVENTION OF COLLISIONS AT SEA.

The recent marine disasters on Long Island Sound and near Sandy Hook, New York harbor, where serious collisions in a dense fog occurred, forcibly bring to the attention of the traveling public the need of some simple method of determining with a reasonable degree of accuracy the relative positions of the respective vessels.

There is no doubt, now, in view of the practical development abroad of wireless telegraphy, an opportunity for the owners of several vessels in one line to equip each steamer with a set of wireless telegraph instruments arranged to communicate with each other.

That being the case it will only be necessary for each vessel to have an operator skilled in the use of the instrument, whose duty shall be, in the event of thick weather, to send out prearranged caution signals at certain regular intervals, and at the same time watch the receiving instrument for replies. When a return signal is received, then communications as to the location and course of the vessels can be easily made and a prospective collision avoided.

It has been shown by the experiments across the channel between France and England that the distance the electrical waves will travel varies with the height of the conducting terminal above the water level. According to W. H. Preece, a conductor 20 feet high will signal well to a distance of one mile, 40 feet to 4 miles, 60 feet to 9 miles, 100 feet to 25 miles. He also states that the electric waves travel over water with greater force than over land.

As the average height of a large steamer mast above this level is 100 feet, the electric waves should be effective for a probable distance of 25 miles.

Such an arrangement would be more certain than the usual fog siren, for the effectiveness of the latter is varied in certain instances by the force and direction of the wind. Wind or stormy weather do not interfere with the working of the electrical waves.

Taking the case of the collision of the steamers "C. H. Northam" and the "Richard Peck" on Long Island Sound a short time ago as an example, the captains of each vessel were brothers; they were on their night trips from New York to New Haven, and vice versa. After starting a dense fog quickly arose. They knew at about a certain time in the night they would pass each other. When that time arrived they were unable to determine each others' whereabouts definitely or to communicate as to the course each was taking, and it happened that the "Richard Peck," which was the stronger vessel, plowed transversely through the bow of the "Northam." She was barely saved from sinking. Had each vessel been supplied with the simple wireless electric instruments, and had they been put in operation as soon as the fog appeared, the vessels would have been able to have communicated with each other within a distance of say 15 miles, and thus easily have avoided a collision.

It seems to us that the interests of the great steamship and transportation lines demand that they should be quick to adopt every known scientific device that can effectually serve as a safeguard against the perils of dense fog or thick weather.

What line or combination of lines will be the first to adopt such safeguards?

METHOD OF TRANSFERRING PHOTOGRAPHIC FILMS.

Several years ago a special transferotype paper was made by which the developed film or picture could be removed and transferred to any desired object or onto glass or a gelatine film.

With the advent of the celluloid and other transparent films the manufacture of the transfer paper ceased.

The celluloid films and similar films are not wholly free from pits, miniature semitransparent dots, brush marks, etc., which magnify seriously when an enlargement is to be made or even when a lantern slide is made by contact with the film.

For the purpose of proving this and securing images of absolute clearness and perfectness, Mr. W. Jennings, of the Photographic Society of Philadelphia, discovered a plan of readily removing the picture gelatine film from the supporting celluloid or transparent support. His explanation of how it is done is as follows:

Dip the film for about half a minute in a 10 per cent solution of alum and water, then lay it on a plate of glass and at the upper corners proceed to roll back the gelatine film gently with the fingers. It readily separates from the support, and in this rolled-up condition it is washed in running water for about five minutes, to take out the wrinkles and eliminate the alum. Then place a clean plate in a tray containing a 10 per cent solution of glycerine and water.

Next take the separated film and spread it out (printing side up on the glass plate in the tray), then lift up the plate and place the film on the plate under slowly running water. This will drive out the bubbles. Use the finger or the tip of the tongue for a squeegee. The film will dry perfectly flat and free from grain. When dry it may be intensified, reduced or retouched as usual. This is an excellent way to save film negatives having joints in the celluloid. I have no trouble in transferring fifty 4 by 5 films in an hour in this way

Positive pictures can just as well be transferred from this supporting film onto other things than plates of glass as one's fancy may choose.

WATER-TUBE BOILERS FOR OUR WARSHIPS.

BY LIEUT. G. L. CARDEN, U.S N.

The Navy Department has decided to introduce in a number of new warships of this country the Niclausse type of water-tube boiler. It was this form of boiler which was employed on the late Spanish warship "Cristobal Colon," and from what can be learned of its workings, good results are expected. The main objection heard against the boiler by engineer experts is the feature of the horizontal tubes. Whether this objection will prove a valid one, experience alone can tell, but in the opinion of the naval officials in Washington, the reports from abroad are all in favor of the new generator.

The Niclausse boiler is of French design. Various types of French water-tube boilers have proved eminently successful, particularly the Belleville and Normand types, and within late years the British Admiralty have made liberal use of these French designs. The British cruisers "Powerful" and "Terrible," the largest protected cruisers in the world, each carry forty-eight Belleville boilers, arranged twenty-four on a side.

In this country recourse has been had both to foreign and domestic designs of water-tube generators, and American warships are now using in a number of instances the Yarrow, Thornycroft, Ward, Du Temple, and other types.

It is the expressed view of leading engineer officials that the troubles experienced from time to time with water-tube boilers have been largely due rather to unfamiliarity with the type in general than to any inherent or ineradicable defects in their design or construction.

In the hands of experienced and alert engineers, water-tube boilers have thoroughly demonstrated their fitness for deep-sea work. It has only been necessary to prove that water-tube boilers are reliable for general cruising purposes to insure their adoption in place of the Scotch marine types. It is the saving in weight afforded by the tubular boiler that so strongly appeals to the naval architect, and in the case of warships the economy thus secured is of more importance than it is in the merchant marine.

The new warship "Maine," building at the yards of the Cramps, will be the first of the new battleships to carry Niclausse boilers. Her sisters, the "Missouri" and "Ohio," will each carry, it is understood, Thornycroft boilers. The design of the "Maine," as finally settled upon, calls for twenty-four Niclausse boilers, arranged in three groups of eight boilers each. Each group will be subdivided by the center line bulkhead, and each boiler will have fifteen elements of twenty-four tubes, the whole number of elements being 360 and the number of tubes 8,640. The "Maine's" boilers are designed to carry steam at a working pressure of 250 pounds per square inch above the atmosphere.

The announcement is now made by naval officials that the water-tube boiler will hereafter be exclusively used in United States warships. In the case of the "Maine" and her sisters the particular type of boiler to be selected was left to the contractors, subject to the approval of the Navy Department. The Cramps selected the Niclausse, and the Union Iron Works and Newport News establishments the Thornycroft. Rear Admiral Melville, chief of the Engineering Bureau, is the authority for saying that it has been definitely decided to adopt water-tube boilers for all our new warships. It is known that Admiral Melville was anxious to incorporate water-tube boilers in the battleships authorized prior to the last group, but it was impossible, it was found, to do so at the last moment, since no hull changes would be permitted.

In the British navy the Belleville water-tube boiler has been adopted for all vessels larger than torpedo craft.

According to the statements of leading British officials, the charges brought against the Belleville boiler have narrowed down to a low efficiency in fuel consumption. The official reports of the engineering departments do not, however, bear out the indictment. The big armored cruiser "Terrible," on her trial trip, recorded a consumption of 1·71 pounds of coal for each horse power exerted for an hour. On the trial of the British cruiser "Diadem," which trial lasted for thirty hours, the coal consumption per indicated horse power per hour was 1·59 pounds. This consumption was the equivalent of 13·9 pounds of coal per hour per square foot of grate surface. On the eight hours full-power trial of the "Diadem," when the coal burnt was increased to 20·8 pounds per hour per square foot of grate surface, the coal was only increased to 1·76 pounds per indicated horse power per hour. Steam was maintained at the engines during the thirty hours and eight hours runs, respectively, at 245 and 249 pounds per square inch.

The announcement of the official adoption of water-tube boilers for the vessels of the United States navy is regarded in engineering circles as a most important one. Briefly summarized the resulting advantages are lightness, ability to raise steam quickly and accessibility for repairs. No trouble is experienced in raising steam to 250 pounds pressure from cold water in much less than an hour's time, instances being recorded of 23 minutes only being consumed. In the case of the cylindrical boiler from six to twelve hours are required. The danger formerly apprehended of tubular boilers breaking down is no longer seriously entertained. Tube boilers like cylindrical boilers must be cared for, and good judgment must be shown in handling them. If this is done there is no reason, in the opinion of naval engineers, why they should not always respond when called on for hard service.

MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Forty-eighth Annual Meeting of the American Association for the Advancement of Science will be held at Columbus, Ohio, August 19 to 26, 1899. The Association headquarters will be located in Room 10, University Hall, Ohio State University, and the hotel headquarters of the Council of the Association will be at the Chittenden Hotel. A meeting of the Council will be held at noon on Saturday, August 19, at the hotel headquarters.

The opening session of the Association will be held at 10 o'clock A. M., on Monday, August 21, in the Chapel, University Hall.

The officers of the Columbus meeting are as follows: President, Edward Orton, Ohio State University, Columbus, Ohio. Vice Presidents: Mathematics and Astronomy, Alexander Macfarlane, Lehigh University, South Bethlehem, Pa.; Physics, Elihu Thomson, Lynn, Mass.; Chemistry, F. P. Venable, University of North Carolina, Chapel Hill, N. C.; Mechanical Science and Engineering, Storm Bull, University of Wisconsin, Madison, Wis.; Geology and Geography, J. F. Whiteaves, Geological Survey of Canada, Ottawa, Canada; Zoology, S. H. Gage, Cornell University, Ithaca, N. Y.; Botany, Charles R. Barnes, University of Chicago, Chicago, Ill.; Anthropology, Thomas Wilson, Smithsonian Institution, Washington, D. C.; Social and Economic Science, Marcus Benjamin, United States National Museum, Washington, D. C. Permanent Secretary, Dr. L. O. Howard, Cosmos Club, Washington, D. C. General Secretary, Frederick Bedell, Cornell University, Ithaca, N. Y. Secretary of the Council, Charles Baskerville, University of North Carolina, Chapel Hill, N. C.

The affiliated societies which will meet with the American Association are the American Forestry Association, the Geological Society of America, the American Chemical Society, the Society for the Promotion of Agricultural Science, the Association of Economic Entomologists, the American Mathematical Society, the Society for the Promotion of Engineering Education, the American Folk-Lore Society of America, the Botanical Society of America, and the American Microscopical Society.

It is expected that the Columbus meeting will be of great importance and interest, and attractive excursions will be arranged, and the usual receptions will be held.

ARMOR PLATE FOR BANK VAULTS.

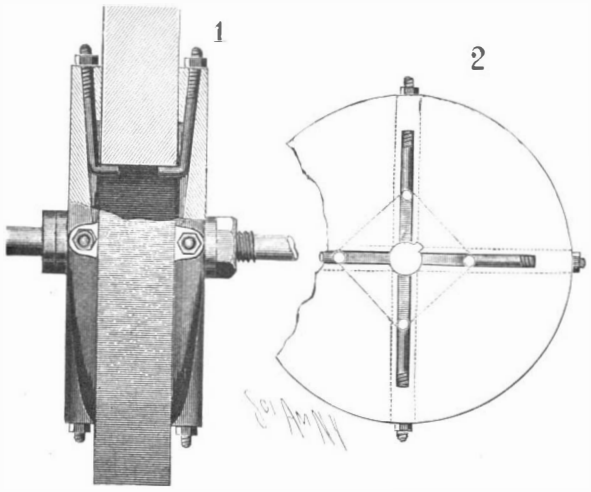
A Pittsburg trust company has lately erected a vault, composed of steel armor plates, which possesses some novel features. It is 19½ feet by 16½ feet by 9½ feet. The entire front of the vault is of a single plate of armor 8 inches thick. This is reinforced by a nickel-steel plate of the same size, only 6½ inches thick. Therefore the total thickness is 14½ inches. The door is in the front, and the bolt-work of the door radiates from the center, like spokes from a hub. The armor plates are dovetailed together, and clamped from the inside. If desired, plates 22 inches thick can be used, thus avoiding the use of bolts. It is thought that armor plate vaults possess remarkable advantages over the old laminated plates. Other banks are about to adopt the new system.

AN IMPROVED HANGER FOR GRINDSTONES.

The device which forms the subject of the annexed engravings is a simple form of flange for the hangers of grindstones, capable of being readily applied to sustain the stone in a true running position.

Fig. 1 is a partial vertical section showing the hangers applied to a grindstone. Fig. 2 is an inner face view of one of the flanges in position, the eye of the stone being shown in dotted lines to illustrate the position of the hanging devices relative to the eye.

The hanging device for the stone consists of two flanges or clamping heads provided with four radial offsets each having a longitudinal bore extending from its outer end to a recess in the inner face of the flange. In the bores hanging-arms are located having at their



BIRD'S GRINDSTONE-HANGER.

inner ends heads bent at right angles to the body-portions. At its outer end each hanging-arm is threaded to receive an adjusting-nut, by turning which the head-portion of the hanging-arms are raised or lowered.

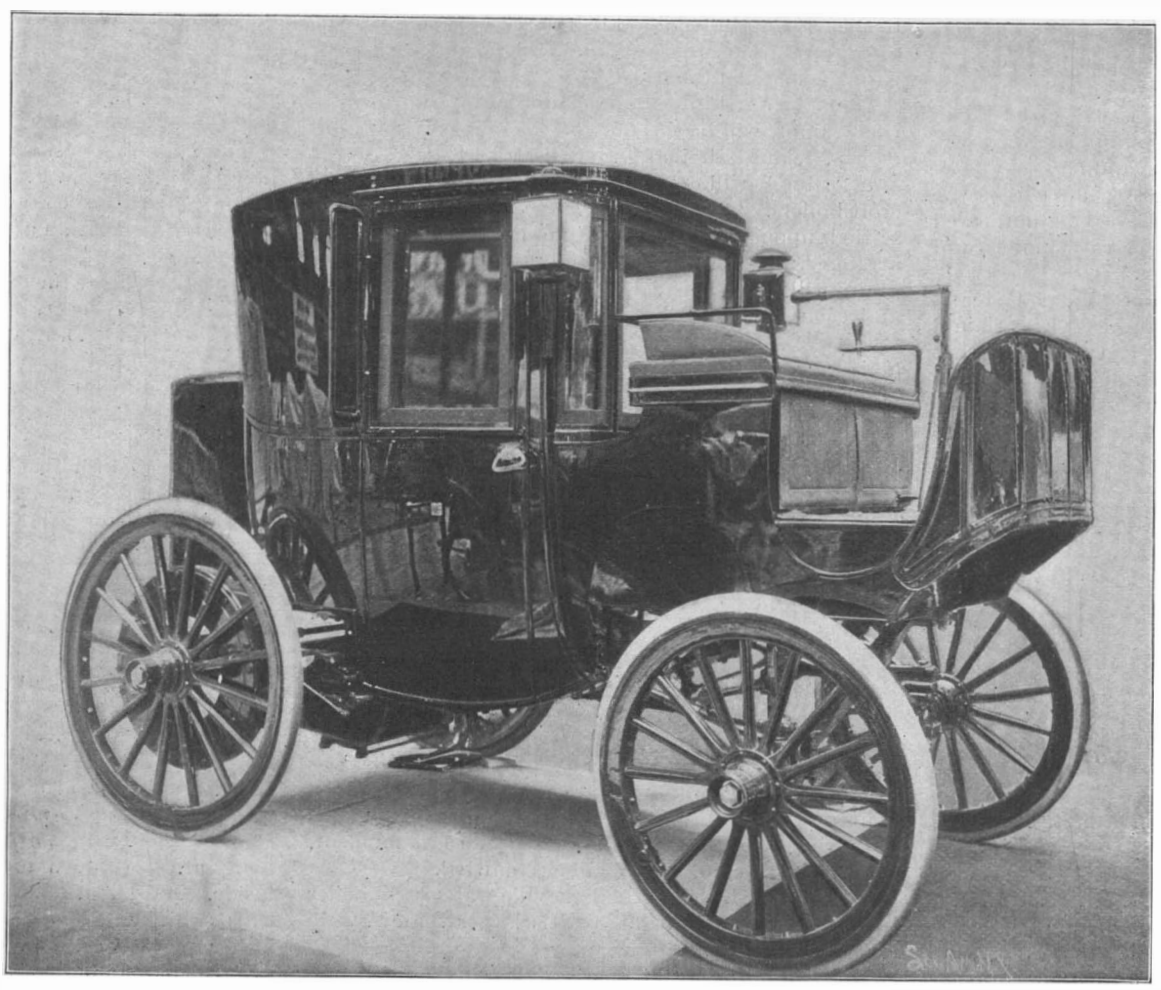
In applying the hanger, one of the flanges is slipped upon the spindle of the stone, until it engages a collar on the spindle. The stone is then placed upon the spindle and the heads of hanging-arms of the flange already in position are made to engage the corners of the rectangular eye. The second flange is next placed on the spindle; and the heads of its hanging-arms are likewise made to engage the corners of the eye. A lock-nut is finally screwed upon the spindle to force the flanges firmly against the stone. If the stone be not exactly true, the proper hanging-arms are adjusted through the medium of their nuts until the true position has been obtained. The inventor of this improved hanger is Fletcher M. Bird, of Wenatchee, Wash.

AUTOMOBILE BROUGHAM FOR A CITY PHYSICIAN.

We present an illustration of one of the most handsome automobiles that has hitherto come under our notice. It was recently completed at the works of the Pope Manufacturing Company, Hartford, Conn., for the use of a leading physician in New York city, and the instructions were that it should be given such lines and finish as would enable it to compare in appearance with the best horse-driven turn-outs. It was shown at the recent Electrical Exhibition in this city, and will, no doubt, be familiar to many of our readers. The body is given an easy riding motion upon heavy platform springs at the rear, and a compound Brewster spring at the front. The batteries are carried in two boxes placed under the driver's seat, and in two boxes which are carried at the rear. The interior, luxuriously upholstered in satin, broadcloth and leather, contains such conveniences as an electric reading lamp, hand mirror, pockets and shelves for parcels, and a small clock set in the upholstery. An electrical signal operated by a push-button on the inside of the brougham affords communication with the driver.

The vehicle is driven by a 40-ampere motor which is capable of giving 83 per cent efficiency at normal load and 78 per cent efficiency at 150 overload. It is spring-suspended and drives through the balance gear and a single reduction. The standard type of wheels used on the Columbia automobiles are a modification of the bicycle wheel, with heavy 3-inch pneumatic tires, the changes being in the direction of greater strength and size. In the present case, however, in accordance with the wishes of the owner, the wheels are of wood and the tires are solid rubber. The weight of the battery is 1,375 pounds and the complete carriage weighs 4,100 pounds. The coachman has the steering handle on his right and the controller handle at his left. The controller has four movements from "stop" to full "speed." The brake and reversing levers are operated by the left foot, the former consisting of a bronze band which is tightened over an iron drum on the rear driving-axle. The brougham is provided with a powerful electric bell which is rung by pressing a push button placed in the end of the controller handle. A meter is placed conveniently in sight of the coachman by which he may read at sight the condition of the batteries.

The average running speed is about eight miles an hour, but a maximum speed of eleven miles can be obtained if urgency renders it desirable. The vehicle is capable of covering twenty-five miles under ordinary conditions on a single charge of the batteries.



AUTOMOBILE BROUGHAM FOR A CITY PHYSICIAN.

The "Life Plant" of Guadeloupe.

Consul Aymé, of Guadeloupe, has sent with a report dated December 24, 1898, some leaves of a plant growing wild on the island, which he calls the "life plant," on account of its peculiar properties. Mr. Aymé says:

"If any leaf be broken from the plant and pinned by the stem to the wall of a warm room, each of the angles between the undulations of the leaf margin soon throws out a number of very white thread-like roots. Next a tiny plant begins to sprout, which in the course of two or three weeks attains a height of two or more inches. When the original leaf begins to shrivel, which may take from six weeks to three months, the small plants may be cut out with scissors and planted, or the whole leaf buried, when the young plants will rapidly attain full size. When cultivated, the plant attains a height of four feet and produces graceful red and yellow flowers.

"I believe that this plant could be successfully grown as a house plant, and certainly in any ordinary greenhouse. I find that old and new leaves sprout with about the same readiness."

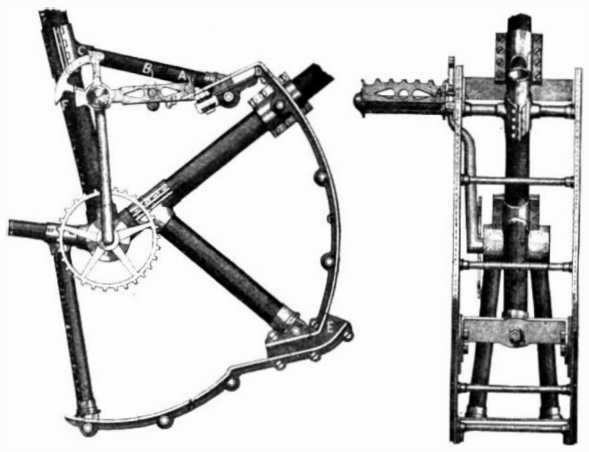
The Breaking of a Waterspout.

On June 15 a waterspout was seen sweeping toward the town of Hennessey, Oklahoma, and for the third time this year it has been saved from destruction by artificial means. One of the Rough Riders, John Rhoades by name, bought four old cannon, in Cuba, and the citizens of the town purchased them, and the city council employs a man to attend to them. When a waterspout or cyclone appears on the horizon, he mounts his horse and rides to one of the cannon, which are placed on the outskirts of the town, one on each side. The cannon was loaded with salt, and was fired on June 15, at forty rods range, into the whirling black mass that threatened the town with destruction. The city is protected by this means at a trifling expense, and so far it has always worked satisfactorily.

AN INGENIOUS BICYCLE GEAR.

The attention of many inventors has been engaged in devising a bicycle gear in which the relative positions of the pedal and crank constantly change during each revolution to keep the thrust exerted by the rider on the pedal approximately at right angles, so as to insure a full utilization of the power exerted. An ingenious gear of this character has recently been patented by Dr. Cephas Whitney and Mr. Alfred C. Lazarus, of 999½ Harbour Street, Kingston, Jamaica, B. W. I., and is shown in side and end elevation in our illustrations.

The gear is provided with the usual crank-shaft, sprocket, cranks, and pedals. Each pedal is pivoted at one end to the crank and is provided at its outer end with a roller, *A*, capable of engaging a cam-race, *G*,



THE WHITNEY-LAZARUS BICYCLE GEAR.

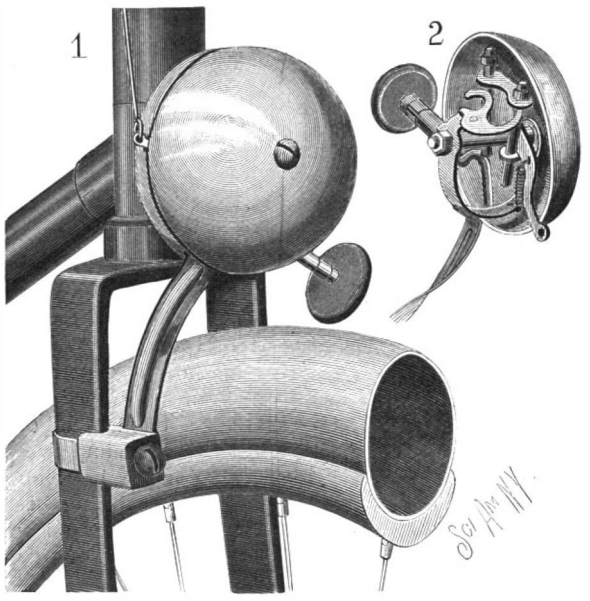
secured to the frame. The two cam-races for the two pedals are connected with each other by rods. At its upper end the cam-race, *G*, is provided with an inwardly and downwardly extending spring, adapted to be engaged by the roller, *A*, at the time the pedal is in an uppermost position, so that the pedal stands horizontally or nearly so. When the rider presses downwardly and forwardly on the pedal, the roller, *A*, rides up and cushions on the spring before mentioned, while the crank travels downwardly. When the roller, *A*, nears the uppermost end of the spring, then the pedal has swung relatively to the crank, and the pedal is now locked to the crank to form an extension. For this purpose the pedal is provided with a hook, *B*, capable of being spring-pressed into engagement with a lug, *C*, on an extension of the crank. During the further movement of the crank the roller, *A*, travels down the segmental part of the race, *G*, but not in contact because of the rising at its upper end. When the roller finally leaves the lower end of the segmental part of the race, it enters the race, *E*, thus causing the swinging of the pedal outwardly relatively to the crank so as to move the hook, *B*, into engagement with the lug, *F*, situated at right angles to the lug, *C*. The pedal now stands again at angles to the crank, and during the movement of the roller, *A*, in the last part of the cam-race remains in this position but not in contact with the cam-race, until it comes again in contact with the spring, owing to the rise at the beginning of the last or lower part of the cam-race. When the crank finally swings up on the return stroke, then the pedal is pushed forward again to assume the position shown in the side elevation at the time the crank is on uppermost position.

Phosphorescent Strontium Sulphides.

According to Mourelo (Pharmaceutische Centralhalle) the property of phosphorescence is not attributable to pure strontium sulphide, but is caused by certain impurities in same, especially strontium sulphate, sodium chloride, as well as bismuth oxide and bismuth sulphide. Bismuth seems to be, pre-eminently, the really active substance, as experiments with artificial mixtures have shown. The best results were obtained with a compound of bismuth subnitrate, 2 grammes; strontium carbonate, 100 grammes; sodium carbonate, 2 grammes; and sodium chloride, 0·12 grm.

THE MOSSBERG TIRE-BELL.

The tire-bell has now been used for no inconsiderable time, and seems to have met with the approval of most wheelmen. Like most bicycle appliances, the tire-bell has been so improved since its introduction, that it bids fair to supplant the handle-bar bell. Among the improved forms should be mentioned a bell made by the Frank Mossberg Company, of Attleboro, Mass., which embodies in its construction certain principles not uninteresting from the mechanic's standpoint. The striking mechanism of the Mossberg bell consists of two steel rods or hammers sliding freely in guides. By a revolving cam-shaft these hammers are caused to move alternately upward and strike the gong. Gravity and rebound bring these hammers back to their original position ready to be again impelled upward by the rotation of the cam-shaft. The power required in ringing the bell overcomes only the weight of the hammers and the rotative friction of the cam-shaft. The cam-shaft with its friction wheel is mounted radially to the axis of the bell. The bells are mounted on a stud and, together with the cam-shaft, are swung in the main bracket by pulling on a cord, to bring the friction-wheel in contact with the tire.



THE MOSSBERG TIRE-BELL

THE MOSASAURS.

BY L. P. GRATACAP.

The American Museum of Natural History has acquired through its Curator of Vertebrate Palæontology, Prof. Henry F. Osborn, a remarkable example of an ancient marine lizard—if this term has a proper significance in connection with these fossils—which was procured from its owner, Mr. Bourne, of Scott City, Kansas.

This unique object is now exhibited, properly framed and protected, on the walls of the hallway in the fourth story of the museum, and certainly produces a distinctly impressive realization of vanished faunal conditions on our earth. In a long sigmoidal curve, with its fore and hinder appendicular skeleton fully revealed, its long skull in complete preservation, with a row of sanguinary teeth, and its tail almost fully shown, this saurian displays its proportions, the relations of its parts, and even meets, half-way, the pleased imagination of the spectator, by a simulated expression of ferocity and predaceous pursuit.

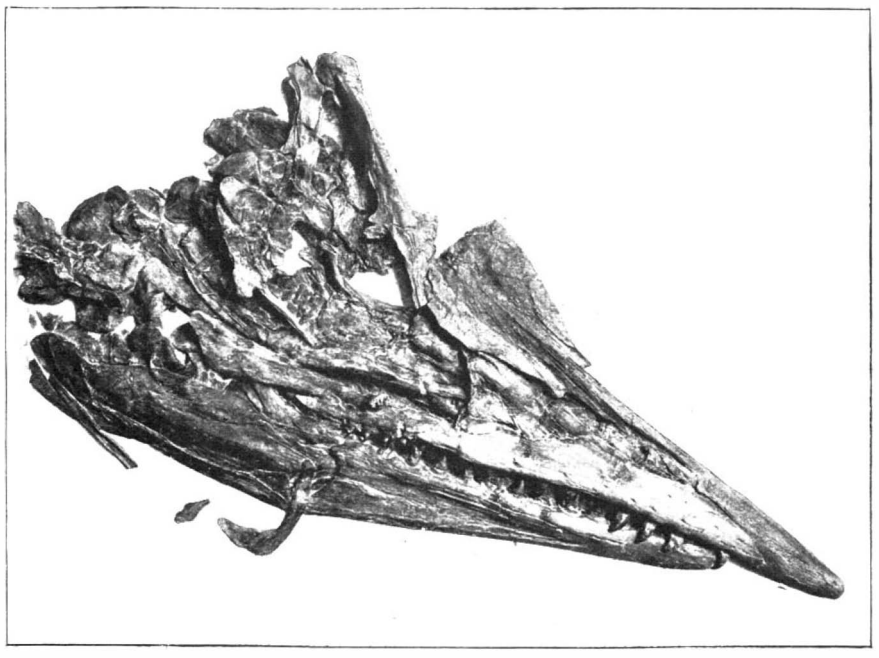
The Mosasaurs, to which this fossil belongs, are not novelties in the world of science, nor are their remains unusual. Hundreds of skeletons have been deposited in Yale College by Prof. Marsh, though more or less fragmentary. Prof. Cope possessed them in his cabinet, the University of Kansas owns a long series of their skeletons, and they have been exhumed from the Cretaceous beds of North and South America, New Zealand and Europe. As long ago as 1780 the famous individual from the Maestricht beds in Holland was procured by Dr. Hoffmann, a surgeon, whose claims to its possession were disputed by a Canon of the Church. Finally, confiscated by this theologian, it became the interesting cause of a general order by the commander of the French troops in 1795. Learning, upon his siege of this city, that a certain house contained the precious remains, orders were given to avoid its demolition. Upon the entrance of the troops, however, the skull was not found. It had been removed. A promise of 600 bottles of wine for its recovery very quickly revealed its retreat, "for the next day a dozen grenadiers brought the specimen in triumph to the house of the representative, and it was subsequently conveyed to the museum in Paris." Besides their numerous representations in museums, Marsh, Cope, Goldfuss, Dallo, Boulenger, Owen, Baur, Williston, Hector, have studied and discussed their nature from the evidence of many other specimens. The distinction of this example, here shown, is its remarkable completeness, for with the exception of a few digital bones and some two feet of its caudal vertebræ it is almost entire.

These large swimming reptiles lived during the deposition of the Upper Cretaceous, and seem, throughout their world-wide distribution, to have ranged within identical geological limits. In this country they occur in the Cretaceous, in New Jersey, Wyoming Kansas, Alabama, Dakota. Their occurrence was a little earlier in America than in Europe, and in New Zealand than in America, leading to the possible deduction that a center of radiation may have been localized in the latter area.

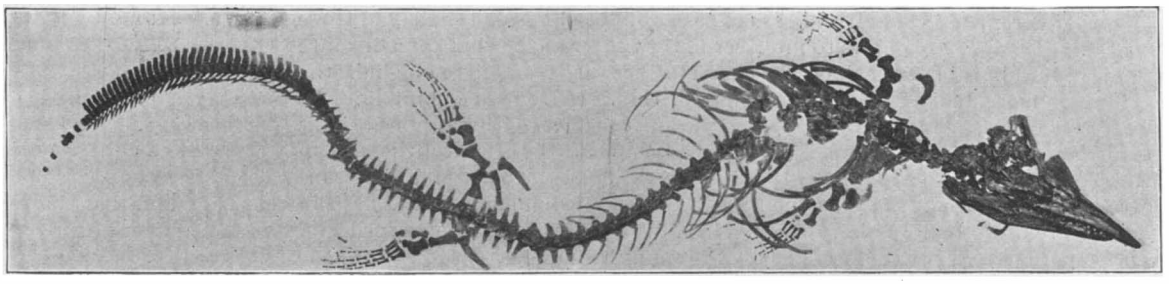
The species here figured and exhibited at the museum is Tylosaurus prariger Cope, and belongs to one of the three great divisions into which the Mosasaurs, by Williston, have been conveniently grouped, viz., the Tylosaurinæ, the Platecarpinæ and the Mosasaurinæ, a division recognized under a different terminology by other investigators.

In Clidastes, as an example of the Mosasaurinæ, a slender and shorter body, powerful tail, numerous teeth, medium sized paddles, few phalanges, are distinguishing features. In Tylosaurus, greater length, small paddles, numerous digits, slender head, separate it superficially from its congeners. Platecarpus is believed by Williston to have been the monarch among these marine monsters, combining flexibility and strength, with large paddles, broad skull, few and powerful teeth. The Tylosaurus probably furnished the largest individuals, though, in contrast to the sensational claims of some writers for a length of one hundred feet, their maximum size did not exceed forty-five. These marine lizards were covered by a scaly skin, and a portion of this integument with its carbonized scales is on view in the museum of the Kansas University. Williston conjectures that these creatures did not inhabit deep waters as the Plesiosaurs, but flourished in bays and estuaries, enjoying a rather narrow range of locomotion and feeding for the most part on fishes.

Two extracts respectively from Williston and Cope may suggestively close this brief description. "While the flexibility and loose union of the jaws doubtless permitted animals of considerable size to be swallowed, the structure of the pectoral girdle would never have permitted any such feats of deglutition of which the python and boa are capable. . . . It has been supposed that the prey, after seizure, was pulled down the throat by the alternate protrusion and fixing of the separated jaws. This, however, could not have been true. The mandibles in front, while not rigidly connected, yet show ligamentous union, and the quadrates were largely fixed posteriorly. . . . Possibly a saurian of the largest size might have swallowed entire an animal as large as a two-year-old calf, but I doubt the possibility." The following more speculative statement is from Cope: "The habit of swallowing large bodies between the branches of the under jaw necessitates the prolongation forward of the mouth of the gullet; hence the throat of the Mosasaurs must have been loose and almost as baggy as a pelican's. Next the same habit must have compelled the forward position of the glottis or opening of the windpipe, which is always in front of the gullet. Hence these creatures must have uttered no other sound than a hiss, as do animals of the present day which have a similar structure, as, for instance, snakes. Thirdly, the tongue must have been long and forked, and for this reason: Its position was still anterior to the glottis, so that there was no space for it, except it were inclosed in a sheath beneath the windpipe, when at rest, or thrown out beyond the jaws, when in motion."



HEAD OF TYLOSAURUS.



FOSSIL SEA LIZARD.

The city and the public of New York are to be congratulated that so superb a specimen of these extinct water pythons can be seen in their Museum of Natural History. It is naturally and truly an object of intense interest.

The specimen itself came to the museum in a few large masses of chalk, from which it has been slowly developed by skilled workmen, revealing from day to day new indications of its perfection. It is stated by Prof. Osborn that cartilaginous supports of the trachea and some of the anterior ribs are retained in this skeleton, and that these vestiges will afford new or decisive evidence as to the zoological position of the Mosasaurs.

Portable Museum for Scholars.

The Brooklyn Museum of Arts and Sciences has just purchased the first "musée scolaire" ever brought to this country. It consists of a system of charts devised by a French publisher of educational material. A small percentage of common school pupils ever visit the great natural history museums, or if they do, they are overwhelmed by the enormous bulk of the collections. Only prosperous private schools can afford a museum collection, and with a few trifling exceptions, the least said about them the better. The portable scholars' museums are intended to give students just exactly what they crave to know, and no pupil, however adverse to study and dry-as-dust subjects, would ever find a natural history lesson dull if it was illustrated by these charts. A whole set of charts can be purchased for less than $100, and they will give the student a considerable grasp upon the subject, although, of course, the charts are necessarily elementary.

The charts or object cards, as they might be called, have actual samples of raw materials fastened to them, and other specimens, showing the various stages of manufacture, and finally the finished product. The various articles are wired to the charts and explanatory legends in French give the necessary description. Some of the charts are obtainable in English, and if there is a considerable demand for them, probably they will all be published, with translations of the text. In the manufacture of linen, for example, specimens of flax are secured to the top, and the series is continued until finally the bleached or finished linen is represented by a small square of cloth. The charts are so portable that it would seem possible for the whole museum to be transported from school to school in country places, somewhat after the fashion of the traveling libraries, as there is almost no danger of breakage. In many out-of-the-way places where a knowledge of natural history and the arts is very limited, these systematic charts would be the entering wedge for much popular advancement of knowledge.

Bottle Closure for Sterilized Liquids.

For this purpose J. Every recommends a simple good cork stopper, which has been pierced by means of a redhot iron wire, almost from the middle of the side diagonally to the middle of the under side of the cork. During the sterilization, place the cork on the bottle in such a manner that the lateral opening is just above the neck of the bottle, thus allowing the air to escape. When the sterilization is finished, press the cork deeper into the neck of the bottle, producing in this manner an airtight closure.—Pharmaceutical Zeitung.

THE THEORY AND CONSTRUCTION OF BALL BEARINGS.

BY W. H. HALE.

Up to the date of the advent of the modern bicycle, ball bearings had no practical application. They were scientific toys, mechanical curiosities, of admitted excellence, truly, but far too complicated and delicate for ordinary use. But when man became his own horse, the first task for his ingenuity was the devising of means for lightening his labor. And the ball bearing proved to be foremost among such means.

But the bicycle manufacturer, instead of starting with the theory and principles of ball bearings, and designing a ball bearing perfectly adapted to the bicycle, took the appliance as he found it, and placed

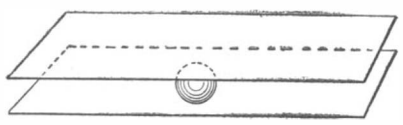


Fig. 1.—IDEAL BALL BEARING—FRICTIONLESS.

it on his bicycle, only making such changes as were absolutely necessary to make it conform to its new conditions. At the present day, twenty years and more after the advent of ball bearings into every-day mechanics, there are to be found many of the troubles and much of the construction of the earlier types.

In the opinion of the writer the most vital parts of a bicycle are its bearings. These should be constructed to run with the least possible friction under service conditions for the longest possible time with the least possible care. These may seem to be unattainable conditions, and it is granted that they are, but their approximation should be the aim of every builder of "high-grade" bicycles. The present universal test of the running qualities of a bicycle ball bearing is to raise the wheel from the floor and spin it, noting the lapse of time till it comes to rest. This is no test of the bearing under service conditions. Many makes of bicycles might be cited whose wheels spin beautifully without a load, but which weary the rider most unaccountably when ridden upon.

We have seen that the superiority of ball bearings lies in the fact that rolling friction is less than sliding. Further study of the subject will disclose the additional facts that—like wheels—balls must be proportioned to the loads they carry and the surfaces on which they travel; and it is these last two conditions, which have been overlooked or ignored, that require solution if the ball bearing is ever to come into general use. That bicycle builders do not understand the principles of ball bearings is proved by the fact that a careful observation of any considerable number of bicycle ball bearings will show that there is no uniformity in either the shape or size of the ball cups, the size or number of the balls, or the shape or angle of the cones. And as these bearings are intended to accomplish identical results, there must be either extreme elasticity in the science of ball bearing construction, or else the majority of these bearings are incorrectly designed.

To properly get at the principles of ball bearings it is necessary to go back first to the well-known advantage of sliding friction. If a man desires to move a box along a floor, he pushes it. A certain amount of force is required to do it. If he can slide it only by great effort, he places a roller under it, when he moves it with ease. This demonstrates the superiority of rolling over sliding bearings. If, now, he places another roller in contact with the first he will find that the box will move easier than when slid, but not so easily as when on one roller only, and this increase of friction is due to rubbing or sliding of the two rollers on one another; and so on. Balls can, of course, be substituted for rollers, and the result of the experiments will be the same; you will have eliminated the sliding

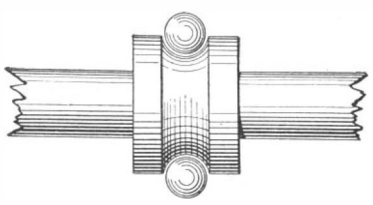


Fig. 2.—FIRST FORM OF BALL RESTRICTION.

friction between the box and the floor, but you will have added the sliding friction between the contact points of the rollers or balls.

The simplest form of ball bearing, therefore, is one ball rolling between two plane surfaces. (See Fig. 1.) Such a bearing is practically frictionless, but it is impracticable in applied mechanics. Two or more balls must be employed and they must be restricted in their path of travel. These necessities introduce two elements of friction, and it is the purpose of this paper to show how this friction may be controlled and reduced.

It will not be necessary to demonstrate that ball bearings are unsuited to plane surface motion—either continuous or reciprocal—and that they find their proper place as bearings for journals, particularly those running at high speeds. As it is necessary to retain the balls in a definite and distinct path of travel, they cannot be made to run between an inner cylinder and an outer cylindrical tube. In such a bearing they would not remain in their proper places. Some means of confinement is therefore requisite. This should be of such a character and should take such a form as to interfere as little as possible with the free rotation of the balls, and is one of our most important lines of investigation. The first method used to accomplish this confinement was to cut a curved channel in the shaft itself within which the balls rotated. (Fig. 2.) Then as means of adjustment for wear were found necessary, the outer track of the balls was also made a channel, but divided in the center, directly in the path of the balls, and the two halves made to advance toward or retreat from one another by means of screw threads cut upon them. Bearings of this character are still in use, although originally designed more than twenty years ago, and this survival is not due to remarkable excellence of design, but to the conservatism of the users. This form of bearing has not only the friction of the balls against each other, but also that of the balls against the sides of the channels.

The first departure from this method consisted in making the channels V instead of U-shaped, in order to make the path of the balls a line instead of a curved surface. To some extent this was an improvement, but it introduced a twisting friction between the balls and their tracks and increased rubbing between the balls themselves, owing to their not rolling on the ends of their vertical diameters. Some of this style of bearings are still in use.

When the present type of bicycle came into existence it became possible to discard the single form of ball bearings and to construct a double one, and it is this type which is now universally used and which invites our attention in this discussion. Typically, these are all alike. They consist of a circular ball cup, with a flat back, forming two points of contact for each ball. These cups are placed at opposite ends of the shaft with their backs toward each other, while outside of them and encircling the shaft are two hollow truncated cones bearing against the balls, their smaller diameters being in contact with or underneath the balls them-

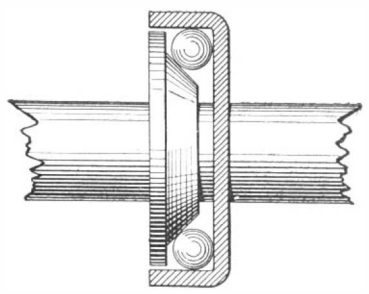


Fig. 3.—SECTION THROUGH ORDINARY BALL BEARING.

selves. Some forms of ball bearings reverse this, placing the cones inside and the ball cups outside, but the type remains the same. This is practically the ball bearing as we know it to-day.

In this form of bearing the balls revolve on three different diameters, varying according to the positions of the three points of contact. They cannot, therefore, obtain perfect rotation in any one plane and must have some sliding friction at all points as well as the friction upon each other. The bearing surface of the shaft can be neither a cylinder nor a disk, for these would be unadjustable; it must therefore be a cone. In the construction of these cones all sorts of arbitrary angles are used, each maker evidently having one of his own which he believes to be—or at least claims to be—the only correct one. The most common angle is 45°, although there are many bicycle builders who could not tell you the angle of the cones they use, and who would not think the matter of any consequence if they could.

The correct angle for a cone should be such as to allow the greatest possible freedom of rotation to the ball and avoid unnecessary wedging and crowding. That of 45° is clearly wrong, for it presents the three most widely separated paths of rotation possible, and therefore causes the greatest amount of twist. What is the best angle then, and how shall we find it? It is evident that it must be less than 45° for even that angle exerts too great a pressure against the back of the ball cup.

If we take a sectional sketch of a ball cup containing balls and draw two lines through the contact points of ball and case of two opposite balls, we shall find these lines to intersect in the center of the shaft at a distance back of the center of the balls equal to one-half the diameter of the ball case. If from this point lines be drawn touching the inner surfaces of these opposite balls a cone is formed whose apex is the center of the prolongation of the axis of rotation of the balls, and whose surface is such as to continuously maintain the balls in this rotation. In addition this cone is governed and determined by the number and size of the balls in the case, size and configuration of the case itself, and the path of the balls.

Another detail that has received far less attention than it deserves is the size and number of the balls used. Quarter inch was the original bicycle size, but a few years ago it was found that larger sizes were better. They did not break nor split so readily, did not roughen up, they did not jam, and they did not wear the cones and cups so rapidly. The $\frac{5}{16}$" was better than the ¼", and the ⅜" better than the $\frac{5}{16}$". These were facts easily proved by demonstration, and the bicycle builder accepted them as such and took advantage of them. He did not seek the cause for the

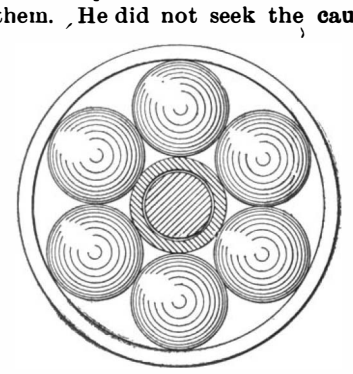


Fig. 4.—FRONT VIEW OF 6-BALL BEARING.

improvement, nor did he try to ascertain how far the improvement would continue.

It remains then for the theorist, the experimenter, to take up this good enough improvement and learn the cause of its superiority, as well as to reason out the possibility of continued improvements up to the logical or practical limit. The question is: If the larger ball makes the better bearing, why does it do so and how long will increase in size continue the improvement?

With a given ball cup and a given size of shaft the largest balls that can be put into the case will have a diameter equal to one-half the difference between the diameters of the shaft and ball cup. But this size of ball could not be used, since there would be no room for the bearing cone, and hence no chance for adjustment. Six is the best and presents the well-known symmetrical appearance of a circumscribed hexagon, and the cone becomes of usable size. Here, too, we note a marked peculiarity; the balls and their bearing cone are approximately the same size.

Experience has shown that too small balls break up in service, and larger balls have been employed until, at the present day, from seven to ten are the numbers generally selected. Decrease in number and increase in size has invariably resulted in improved bearings, but as before stated there has been little or no serious attempt made to ascertain the limit. With every increase in size of ball there is a decrease in the size of the cone until, with six balls, as we have seen, the bearing diameter of the cone and the diameter of the balls are practically the same. This suggests as the logical limit of improvement the point where the wearing diameter of the cone equals the diameter of the balls used.

In designing a ball bearing for general purposes, therefore, which shall embody the principles above presented, the first thing to do is to ascertain the maximum load. This will determine the size of the axle that may be used. As upon this axle is to be placed the hardened cone which serves as the inner bearing for the balls, the thickness of such a cone must be added to the diameter of the axle in order to determine the proper size for the balls. And the diameter of the cone at this bearing point plus twice the diameter of one of the balls used will be the inner diameter of the required ball cup.

If the six ball bearings be adopted, and supposing

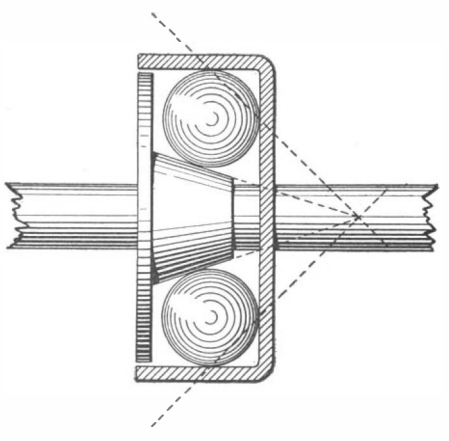


Fig. 5.—SECTION THROUGH 6-BALL BEARING, SHOWING METHOD OF MEASURING ANGLE OF CONE.

that we have found a three-quarter inch axle to be sufficient, the allowance of an eighth of an inch on each side for the bearing cone will be ample, when it is evident that we shall need six one-inch balls for the bearing and that the outer ball cup will have an inside diameter of three inches. It may be argued that this will make a clumsy bearing, that smaller balls will make a smaller cup and give a neater effect. To this it may be answered that clumsiness is merely the

point of view. The present pneumatic tire was clumsy when it first appeared; now the absence of it would be clumsy. Ball bearings to be generally successful must be practical, and to be practical all sentimental regard for appearances must be cast to the winds and such a bearing devised as will best fulfill all the demands that may be placed upon it.

TYPICAL PERPETUAL MOTION FRAUD.

By the courtesy of a correspondent in Bradford, Pennsylvania, we are enabled to present illustrations of one of the neatest perpetual motion frauds that ever drew money from a credulous public or gained for its author a well earned seclusion within the walls of a State prison. Some two years ago, one J. M. Aldrich exhibited to certain citizens of Bradford "a machine which he called a motor," and on the strength of its unique performances secured several not inconsiderable sums of money from the favored few who were permitted as "parties of the second part" to secure an interest in the invention. Subsequent irregularities in the conduct of the "party of the first part" in these transactions, and a too liberal discrepancy between the promise and performance of the "motor," led to the arrest of Mr. Aldrich and his detention for three or four months in the county jail. Unfortunately for the general public, the Bradford victims feared that they did not have sufficient evidence to secure a conviction, and he was released. "Motor" promotion must have proved a lucrative calling, for, notwithstanding his peep through the open doors of the penitentiary, Aldrich cast his net for fresh victims, and for two years continued, no doubt, to prosper after the manner of his kind. Last March, however, one of his many "half interest" holders secured the model and sent it to the Patent Office, where the perpetual motion was traced to its time-honored source—a concealed spring.

We can conceive it is quite possible that the builder of this "perpetual motion machine" did not set out with any deliberate intention to deceive the public. Like many another, before and since, he was doubtless attracted by this will o' the wisp of the inventor, and started with the honest intention and expectation of building a machine which would run without the assistance of any external agency. The type of motor aimed at was one in which the force of gravity should supply the motive power, and it took the form of a rotating shaft, two transverse arms placed at right angles to each other, and jointed levers which should always present an excess of turning moment on one side of the shaft. As will be seen from our engravings of the machine, disk-shaped weights are carried at the outer ends of two transverse arms which are themselves carried at opposite ends of the main shaft. The weights are adjusted at the ends of swinging arms which are capable of motion through an arc of 90°. The direction of rotation (see smaller engraving) is the same as that of the hands of a clock, and the weighted levers are so attached to the transverse arms that in the downward half of each revolution they fall outward and forward, thus lengthening the radius on which they travel relatively to the center of the main shaft. On the upward half of the revolution, the weighted levers close up and the weights themselves describe an arc of rotation with a smaller radius relative to the shaft. To assist in giving a preponderance of turning moment on the downward half of the revolution, the transverse arms are split in the center and are capable of sliding bodily across the main shaft, as will be clearly seen from the cut. As each transverse arm with its jointed lever and weight rises a little past the horizontal it slides forward and downward, thus throwing the weight on the opposite end of the arm still further from the center and increasing the turning moment on that side, at the same time decreasing the moment on the upward half of the revolution. The transverse arms are kept in place by means of small rocking levers which extend from steadying arms attached to the shaft.

To provide against too rapid motion of the machine and a too prodigal display of its powers, a centrifugal governor is provided near one of the vertical posts which carry the main shaft, and its superabundant energy may also be controlled by a small brake which acts on a flywheel attached to the center of the shaft and is held against the wheel by means of a rubber band.

Now we have no doubt whatever that Mr. Aldrich believed that his extensible arms with the weights flung far out on one side of the shaft and drawn snugly in on the other side, would not only insure perpetual rotation, but in a machine of sufficient size would exert a not inconsiderable number of horse power. As a matter of fact, even in a frictionless machine, there would be no turning moment whatever, and as it was, Mr. Aldrich found that on starting his machine it was very quickly brought to rest by the energy consumed in overcoming the internal friction.

If he had been content, as many another unfortunate had been before him, to consign his machine to the scrap heap, it would have been better for him and for his victims; but being of an ingenious and resourceful mind, and doubtless "tempted of the devil," he conceived the idea of overcoming the troublesome friction by means of concealed clockwork, and acting upon the thought he carefully carved and whittled out the wooden bed plate of the machine and placed therein the springs and the train of gears shown in the illustrations.

The gears were connected with the main shaft by means of a small rod extending through the right hand post, a couple of bevel wheels at the top of the post serving to transmit the motion to the revolving shaft and weights. The model, as it stands on our office table, is certainly a masterpiece of deception, and eminently calculated to deceive the unwary. The problem of concealing the joint, after the "works" had been inserted in the hollowed out base of the machine, was solved by forming a bevel joint and making it coincident with the bottom edge of the base, as shown in our drawing. This has been done so skillfully as positively to defy detection, and the illusion is further assisted by the extreme roughness with which the other joints on the machine have been finished. By pushing the little block, which carries a brake, to one side, it may be lifted away, exposing two openings in the base for winding the springs. Considering the artistic clumsiness with which the whole affair is put together, the worm holes neatly drilled, but drilled with that careless abandon which marks the ravages of the native worm, the coarse, rough jointing of the posts standing in close proximity to the exquisitely finished bevel joints of the base, one cannot but regret that the unquestioned dexterity of the inventor was not directed to a better end.

With perpetual motion so palpably accomplished, however, Mr. Aldrich saw in his creation a means of immediate if unlawful gain. Hence, three things followed: Many simple people were relieved of their money; Aldrich was given space for repentance within Auburn prison; and the SCIENTIFIC AMERICAN is enabled to "point a moral and adorn a tale," for the benefit of the all too easily snared investor.

The Feather-Work of Hawaii.

It is seldom that the native products of the savage or semi-savage races are at all remarkable for artistic beauty, no matter how curious or interesting they may be. Among such products the magnificent feather-work formerly produced by the natives of the Hawaiian Islands may be assigned a very high place. This work consisted of feather plumes, feather-covered helmets and dance masks, of wreaths and tippets, above all, of gorgeous cloaks, covered with feathers of brightly-colored native birds. All the earlier visitors of the Hawaiian Islands mention the feather-work. Mr. Miller Christy, F.L.S., has recently written an interesting article entitled "The Rare Feather-Work of Hawaii," in the English Windsor Magazine, and we obtain our facts from this source.

Although once fairly abundant in Hawaii, specimens of this splendid feather-work are now very scarce and more highly prized than ever, for not only has the art of making it been lost, but the bird whose feathers were most highly prized in the manufacture has become extinct. The making of cloaks and other feather-covered articles of dress or ornament dates doubtless from a very remote period in the history of the islands. In bygone days it was the principal occupation of the wives and daughters of Hawaiian nobles, and the ancient kings had a regular corps of skilled feather hunters who were very expert in their business. In catching the birds, a net or snare was sometimes used, but more often a kind of birdlime made from the sticky juice of the bread-fruit tree was used. This was smeared on the higher branches of the trees frequented by the birds or on long poles set up for the purpose of catching them. Often a live specimen of a brilliant scarlet bird known as the "iiwi" was fastened in the vicinity to act as a snare. It is said that the hunters sometimes transplanted trees to the heart of the forest in order to excite the birds' curiosity. The old bird-catchers were doubtless important men in the community, for feathers were considered to exceed in value any other kind of personal property. The difficulty of obtaining sufficient feathers for the manufacture of a cloak must have been enormous, so that it is little wonder that the cloaks are of such value. The groundwork of all the feather articles is coarse netting made of string manufactured from the fiber of a native grass. The outer side is alone covered with feathers, the shafts of which are so dexterously and closely woven into or sewn onto the fabric of the net that the feathers which overlap one another present a surface as smooth and glossy as the back of a live bird. Among the birds which provided the feathers were the mamo-bird and the oo-bird, also the iiwi-bird and the ou-bird. The cloaks already mentioned were by far the most striking products of the Hawaiian feather-workers. They have been spoken of as "royal cloaks," but only those made solely from the brilliant orange-hued feathers of the now extinct mamo-bird can be properly so described.

The right to wear cloaks made from the feathers of this royal bird was the exclusive prerogative of the king. To all others yellow was in the native language "tabu," whence comes our word "tabooed." One of the yellow cloaks which was worn with a helmet of the same color must have formed a garb of truly royal magnificence. Only one or two of such cloaks are known to have been made. The great state robe and war cloak of the king Kamehameha I. was made up from the smaller tippets of the inferior chiefs; it is 56½ inches in length down the back and 12 feet 4 inches in circumference around the skirt. It is said to have continued to increase in size through eight preceding reigns as each successive monarch added something to its size. With the exception of a very narrow border of red feathers it is wholly of the brilliant yellow feathers of the now extinct mamo-birds. The "mamos" worn by chiefs were covered with feathers of commoner birds, chiefly red and yellow, but the yellow is that of the oo-bird and not of the mamo-bird. The two colors are usually arranged in a simple curved or angular pattern showing considerable poverty of design. The length of the cloaks worn by the chiefs was an indication of their rank.

It is difficult to gain anything but an approximate idea of the number of birds required to make one of these garments. In the case of the royal cloaks the feathers of ten birds would on an average be required for each square inch. By simple computation it will be seen that 20,000 to 30,000 birds will be required to make a royal cloak, so that it is little wonder that one cost $100,000.

Next to the cloaks the most remarkable feather-covered objects produced were large helmets that somewhat resembled those of the ancient Greeks. The frame is of wickerwork over which is stretched a feather covered network. Less remarkable, but equally imposing, were the long-handled feather plumes which were borne by the king and his highest chiefs as insignia of rank and banners in war. These plumes also marked the temporary stopping place of the king or leader. Other feather-covered objects manufactured were dance masks, which consisted of huge heads constructed on a wicker-covered frame and having superlatively hideous features; the mouth stretching from ear to ear, armed with several rows of sharks' teeth and great goggling eyes of mother-of-pearl. As late as 1888 two native nobles wore their "mamos" at the opening of the Hawaiian legislature. When the Hawaiians adopted the dress of civilization, the monarchs, however, still continued to wear the royal mamo at their coronations. Naturally the finest series of Hawaiian featherwork are still to be found in Hawaii, principally in the Bishop Museum at Honolulu.

Automobile News.

In addition to international yacht racing for a cup, we shall now have international automobile races for a cup. The Automobile Club de France will have the keeping of the cup, which can be challenged for by any club in any country, in the name of one of its members. The first contest is to be held in France, and if the French vehicles are beaten, in the country of the winning club. The name, date, and distance of the first race will be decided later.

It is announced that there will be another New York-Irvington automobile race in a few weeks, under practically the same auspices as the race held in 1896. The management of the former race was very much criticised, and it is to be hoped that the shortcomings of those who have the matter in charge will be less in evidence.

Boston, Chicago, and New York will each have their automobile clubs. Some of them are in the initial stage of organization, but they all promise to be successful.

A "stable" of gasoline vehicles has been opened in New York, on West Forty-eighth Street.

Mr. Whitney Lyon drove his Riker electric dos-a-dos trap from New York to Coney Island a few days ago. He covered the round trip of thirty-five miles without recharging the batteries. There were four persons in the trap during the trip. The time from the ferry at Broadway, Brooklyn, to the beach was forty-five minutes. Although the trap was not supposed to cover more than twenty-five miles without a renewal of the charge, there was ample power at the end of the trip.

Home-Made Migranine.

In preparing migranine at home, C. Weinedel proposes to make an admixture of 0·5 to 1·0 of burnt magnesia, in melting the ingredients, i. e., antipyrine 85 grammes, caffeine 9 grammes, and citric acid 6 grammes, whereby the preparation is prevented from getting damp, if the melting temperature had been a low one, which always gives a white product. Even by a mere mixing with admixture of magnesia, a rather stable migranine can be produced.—Apotheker Zeitung.

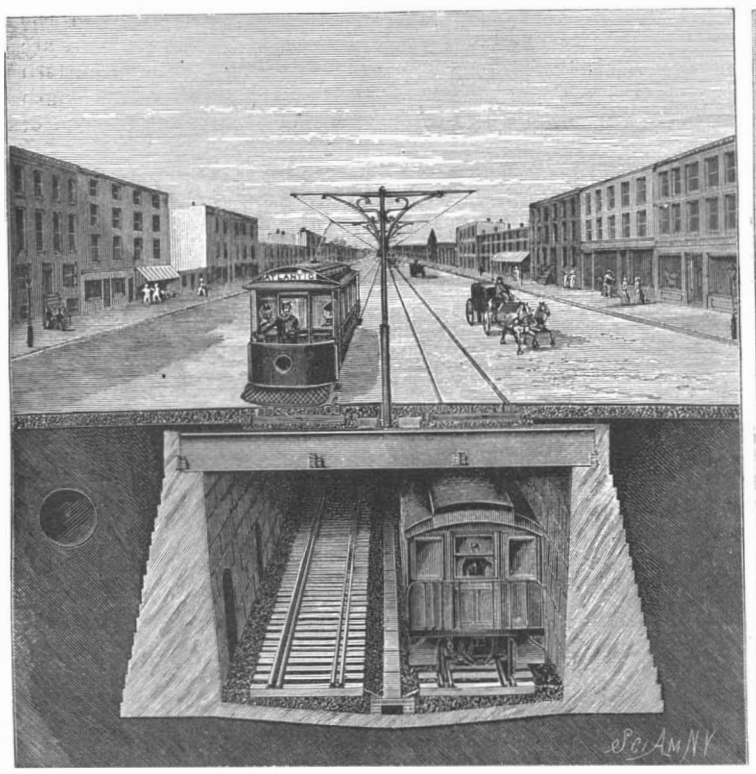
SCORES of prominent people in Washington have taken to cycling this season. Recent converts to the chainless idea include Senators Wolcott and Chandler; Captain Sigsbee, late commander of the ill-fated "Maine;" Assistant Secretary of the Navy Allen, and Rev. Drs. Hamlin and Mackay-Smith.

THE PROPOSED EAST RIVER TUNNEL.

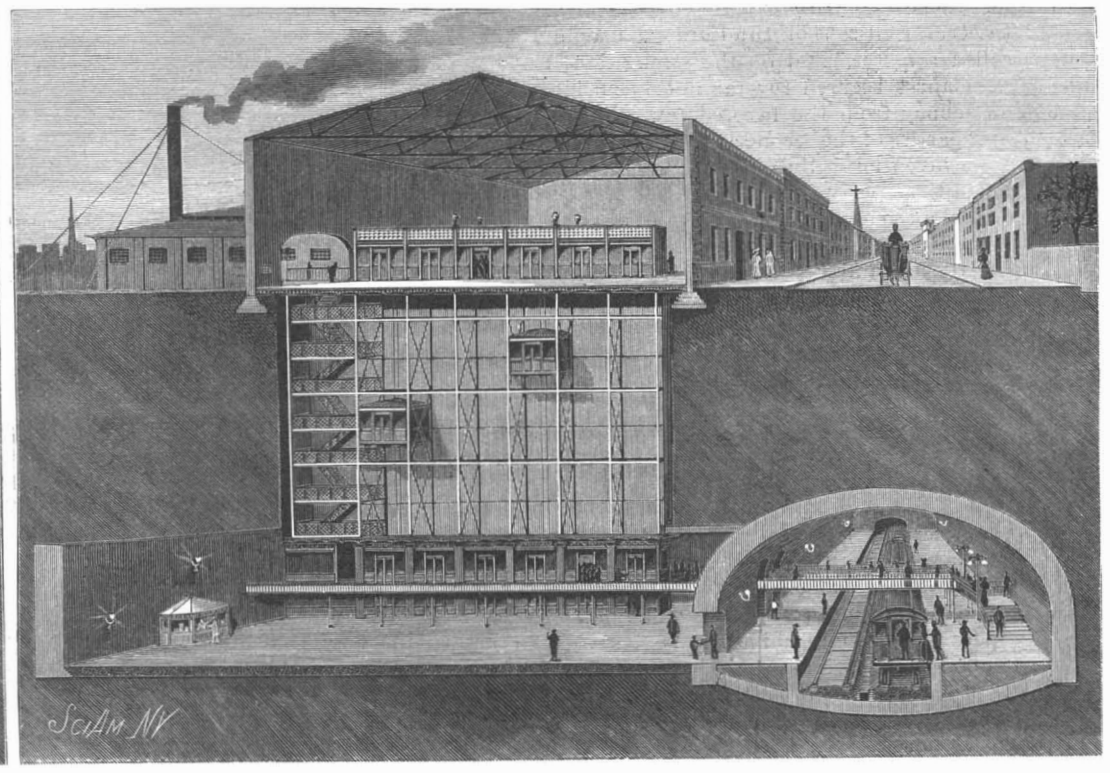
The question of building a tunnel under the East River is just now attracting a large amount of attention and, if we are to believe the press reports, a large amount of capital also. At least three tunnel companies are in the field asking for the necessary franchises, etc. The Long Island Railroad Company's scheme was the first to be mooted, and appears to be practical. The contemplated tunnel is to extend from the foot of Maiden Lane, Manhattan, to the foot of Pineapple Street, Brooklyn. It will be about 2,500 feet in length and is to lie some 30 feet below the bed of the river, or 88 feet below mean tide level. It is to extend beneath Maiden Lane and Cortlandt Street, Manhattan Island, to the North River, and will have two stations on the island, one at Pearl Street, near the Second and Third Avenues elevated railway, and one west of Broadway, adjacent to the Sixth and Ninth Avenues branches of the same system. The extension from West Broadway to the North River is to be carried out with a view to extending it ultimately beneath the river to Jersey City. After passing beneath the East River to Pineapple Street, the tunnel will follow that street to Fulton Street and will extend beneath Fulton Street to a station near the City Hall Square, Brooklyn.

It is estimated that it will take two and a half years to build the tunnel beneath the river. The section lying beneath Manhattan will be constructed through bed-rock, at a depth sufficient to avoid interference with the foundations of the tall office buildings on the lower end of the island. The tunnel, as will be seen from the accompanying engraving, will have an elliptical roof, and its clear width from wall to wall will be 22 feet, while the height at the center will be 14 feet 6 inches. At the foot of Maiden Lane, where the tunnel begins to pass beneath the river, it will divide into two single-track iron-tube tunnels, each 14 feet 6 inches in diameter. On the Brooklyn side of the river the two tubes will reunite in a single double-track tunnel. The tubular portions of the tunnel will be constructed on the Greathead system, which has been so successfully used in various parts of the world. The two shields will be pushed forward simultaneously, and it is calculated that the work will progress at the rate of 5 feet per day. The tunnel will be operated and lighted by electricity, but the particular system of traction which will be employed will not be determined until the excavation is approaching completion, in order that advantage may be taken of improvements in the art which may be made during the interval. The cars to be used in the tunnel will be about the same size as the Brooklyn Bridge cars, and not unlike them in construction. They will be about 50 feet in length and will have both end and side doors, and each car will be capable of seating 60 persons. The proposed speed of the trains is to be between 25 and 30 miles an hour, under a headway of 60 seconds, and the carrying capacity is estimated at about 133,000 seated passengers.

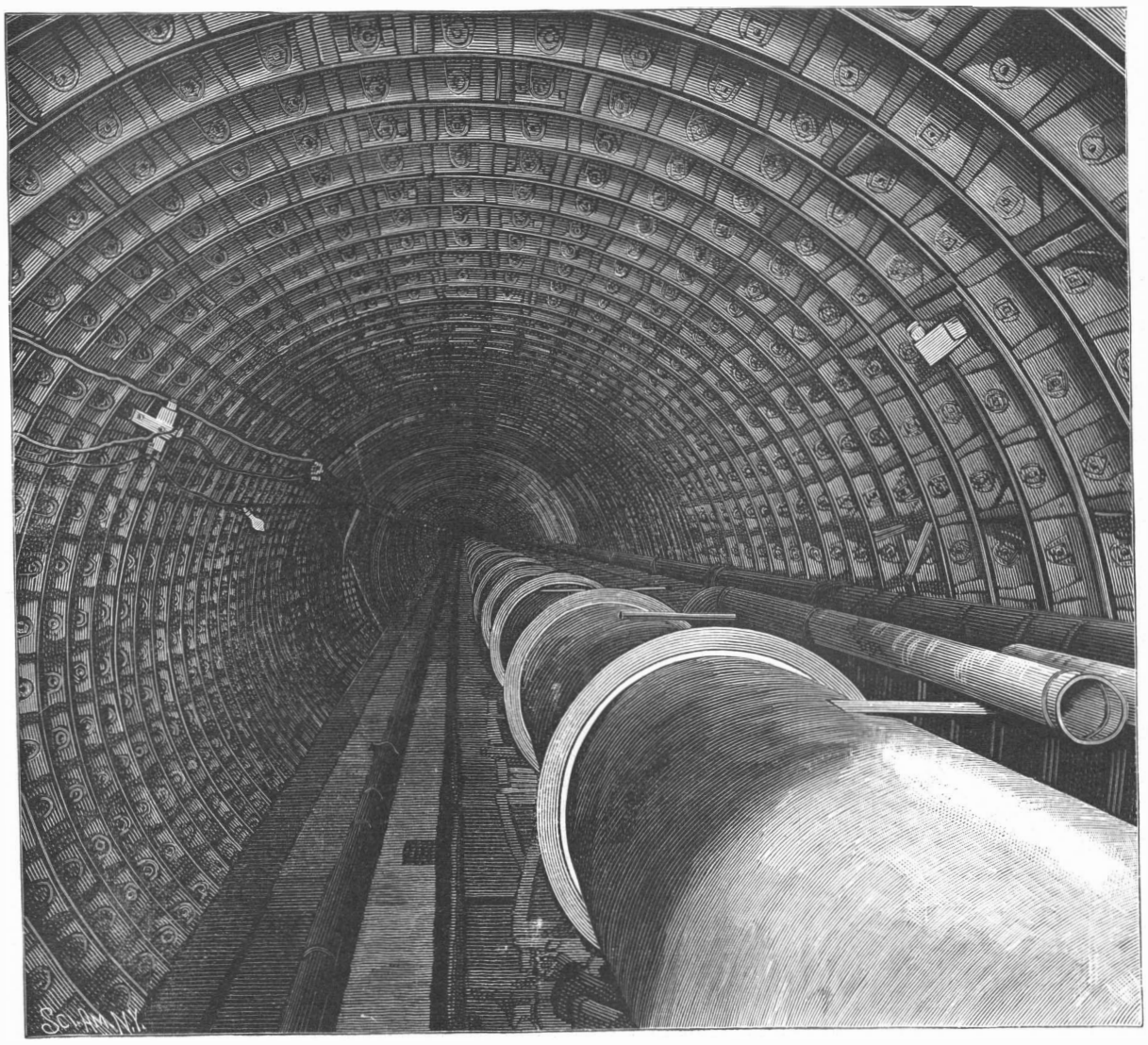
The platform length of each station will be sufficient to accommodate five cars, and to assist in stopping and getting quickly under way all stations will be placed at the summit of a grade. Every station will be served by a group of six elevators, each measuring 14 feet by 10 feet, and capable of carrying sixty passengers. At the bottom of the elevator shaft there will be two landings; the lower one on a level with the westbound train platform while the upper one will be provided with a landing of a height sufficient to clear the tops of the cars, and a foot bridge will be built over the tracks to the opposite platform, so as to avoid any crossing of the tracks at grade. Owing to the short travel of the elevators, it is estimated that their capacity will be greater than the carrying and emptying capacity of the trains during the rush hours. The East River Tunnel is merely a part of the extensive improvements contemplated by the Long Island Railroad. From the station near the City Hall Square,



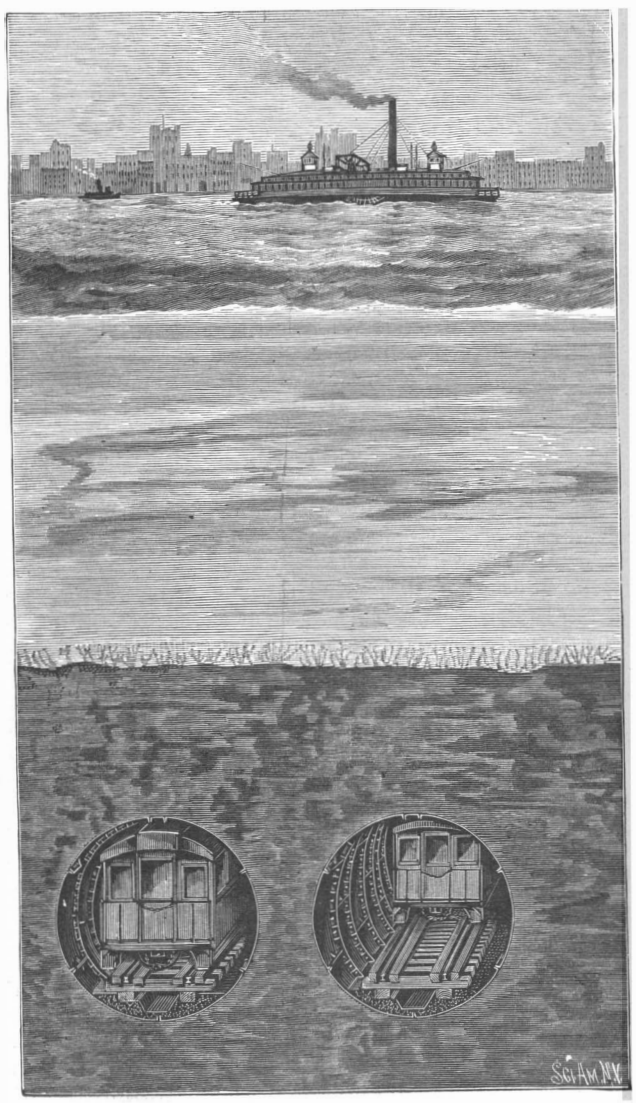
Construction Beneath Atlantic Avenue, Brooklyn.



Type of Station and Cross Section of Deep-level Tunnel.



Tunnel for Gas Mains Beneath East River.



The Twin-tube Tunnel Beneath the East River.

THE PROPOSED TWIN TUNNEL BENEATH THE EAST RIVER.

Brooklyn, the tunnel will extend to the present Flatbush Avenue station, where it will be 18 feet below the street level. From this point to the Franklin Avenue station the tracks will run through a subway and then they will rise through an open cut to an elevated structure, which will commence in the neighborhood of Nostrand Avenue. At Ralph Avenue the road will sink into a subway, which will run under Howard Avenue as far as Manhattan Crossing, from which point it will rise to the surface and continue by an elevated structure to a point near the boundary line of the Borough of Brooklyn. At the Flatbush Avenue station the regular Pullman car and freight service will be maintained. It was not considered desirable to build the tunnel beneath the river of the large size necessary to accommodate standard railway passenger coaches.

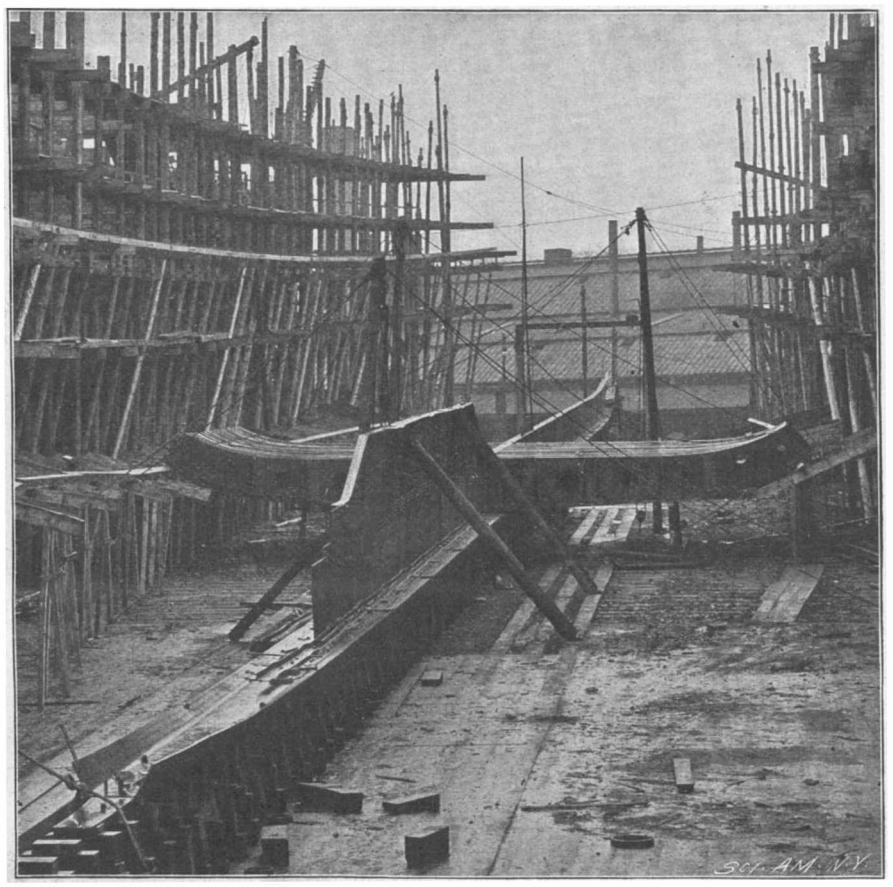
As a matter of fact, the proposed tunnel under the East River will not be the first to be built. A tunnel 8½ feet high and 10 feet wide, as shown in the engraving, sufficiently large for persons to pass through on a handcar, already reaches at the foot of East Seventy-first Street to Ravenswood, passing under Blackwell's Island. The tunnel extends from the plant of the East River Gas Company in Ravenswood to its mains in Manhattan, a large main running through it. It was eighteen months in being built, being completed in July, 1894. It is a thorough success. There has been no trouble with it since its completion, and it shows conclusively that a passenger tunnel is practicable. The amount of seepage is small and might be reduced if it were necessary. The tunnel is 2,516·4 feet long. The top of the tunnel under the channel between Blackwell's Island and the Manhattan side of the river at the point of nearest approach to the bottom of the river is 40·93 feet below the river bed, while under the channel between the island and the Brooklyn side the nearest approach of the top of the tunnel to the river bed is 82·33 feet. The depth of water on the Manhattan side is 65 feet and on the Brooklyn side 30 feet.

The construction of the tunnel under the river bed was by the shield system. The plates composing the walls are 1¼ inches thick, 16 inches wide, and 3 feet long. The edges are deeply flanged and bolted and riveted together. The joints are filled with liquid concrete. Construction was carried on at the rate of 5 feet a day. The capacity of the tunnel is such that it could contain sufficient mains to supply the whole of Manhattan with gas.

BICYCLISTS who suffer injury to their persons or property through collisions with other users of the highways or with road obstructions should always study up on "contributory negligence" before seeking redress at law. Cases of the kind usually afford opportunity for discriminating work in drawing the line between ordinary watchfulness and prudence on the part of the plaintiff and failure to take that reasonable care of himself which is legally incumbent upon every traveler by horse, foot or wheel.

"DEUTSCHLAND"—THE LATEST AND FASTEST OF THE TRANSATLANTIC LINERS.

A striking feature which attends the competition between the steamship companies that ply between England and America is the extraordinary development which has taken place in the last decade in the great German companies, the Hamburg-American and the North German Lloyd. Within a few years they have both moved up to the very first rank, the Hamburg-American being the largest ocean transportation company in the world. Although in this competition the features of accommodation, comfort, and safety have always received great attention, the feature of speed has been the one that has appealed most to the popular imagination. To hold the record across the Atlantic has been one of the chief aims which actuated the policy of the past. It was not until the present decade that the German companies made any effort to approach their English, French, and American rivals in the production of fast ships; but in placing the "Kaiser Wilhelm der Grosse" upon the route, the North German Lloyd Company easily moved up to first place, for this magnificent vessel in one of her early voyages achieved an average speed for the whole trip across the Atlantic of about 22·35 knots an hour and an all-day speed of 23 knots an hour.



KEEL AND ENGINE FOUNDATIONS OF HAMBURG-AMERICAN LINER "DEUTSCHLAND."

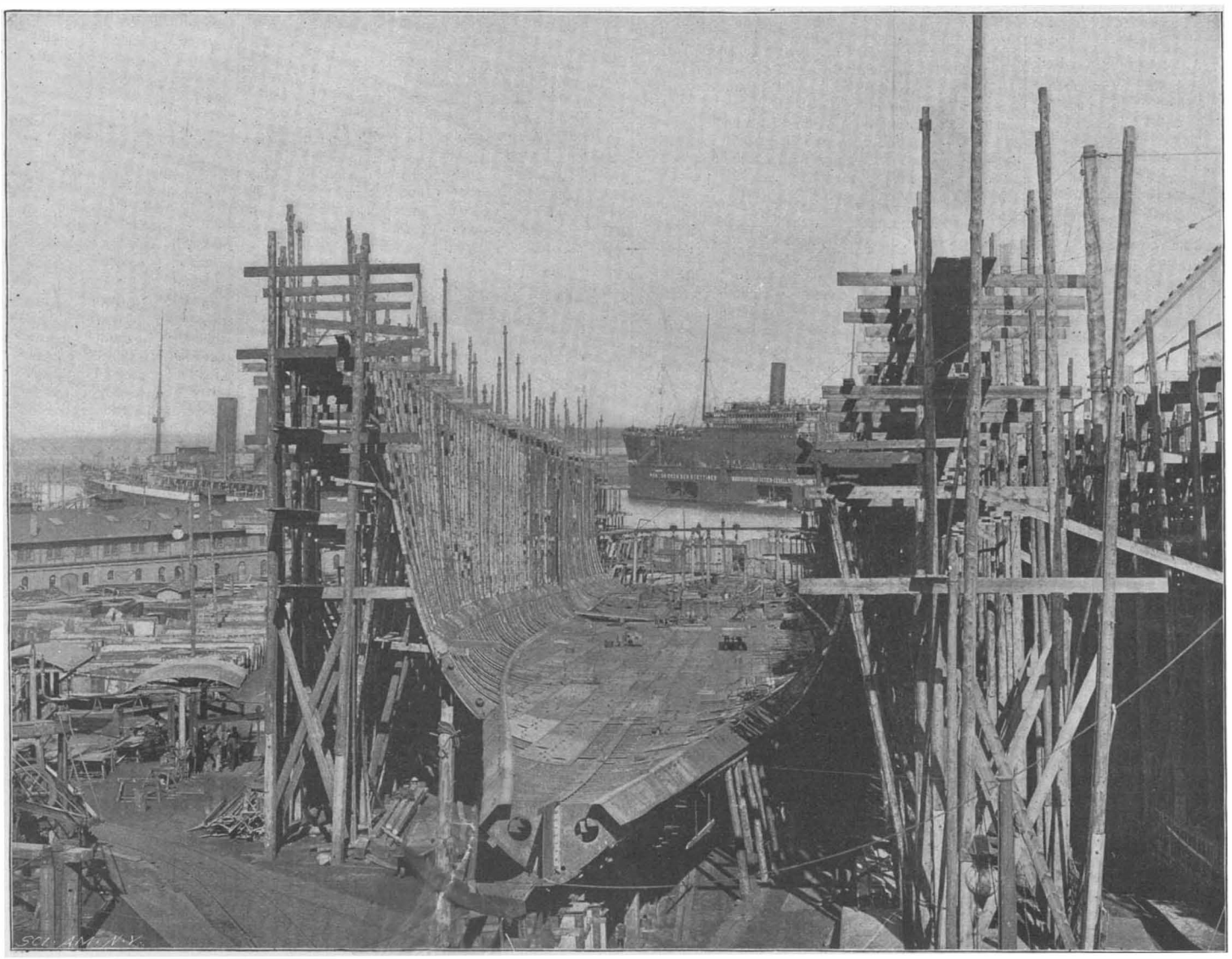
It was only a question of time when the Hamburg-American Company would produce an answer to the "Kaiser Wilhelm der Grosse"; and such a ship is now being built at the Vulcan yards, Bredow, near Stettin, Germany. The new vessel is to surpass the "Kaiser Wilhelm der Grosse" in size, speed, accommodation, and indeed, as far as the intentions of the company go, in every point of comparison. As will be seen from the accompanying table, the new vessel, which will be named the "Deutschland," will be larger than any ship afloat at the time of her launch, except the "Oceanic," of the White Star Line, which is expected to make her maiden trip in the autumn of 1899. The "Oceanic" exceeds the "Deutschland" in every dimension and is only inferior to her in speed; but as was explained in our article on this great ship in the issue of the SCIENTIFIC AMERICAN for February 11, 1899, she is not to be reckoned among the "fliers," as the company will not aim at a speed of more than about 20 knots an hour. The "Deutschland," on the other hand, is to be capable of sustaining a sea speed of no less than 23 knots an hour, something that has never been attempted in any previous transatlantic liner. The dimensions of the vessel are as follows:

Length over all	686½ feet.
On the water line	662 "
Beam	67 " 4 inches.
Depth	44 "
Average sea speed	23 knots.

There are to be 264 first-class cabins, providing for 736 berths; 100 second-class cabins with 300 berths; and 282 steerage berths, making a total of sleeping accommodation for 1,320 people.

To realize such high speed in so large a vessel will, of course, require engines of unprecedented size and power. The "Campania" has about 30,000 horse power and the "Kaiser Wilhelm," whose model is probably finer than that of the "Campania" is credited with 28,000 horse power, but the new ship will have engines and boilers capable of maintaining, day and night, an aggregate output of 35,000 horse power. The boiler plant will consist of twelve compound boilers, each provided with eight furnaces, and four single boilers with four furnaces each; thus there will be altogether 112 furnaces to feed in the stoke hold of the vessel. The steam pressure will be 225 pounds to the square inch. While the sea speed is to be 23 knots an hour, the trial speed calls for 23½ knots an hour, and it is not unlikely that this will be exceeded by fully a knot, in which case the huge vessel will be traveling at the unprecedented speed for a large ship of 28 land miles per hour.

The passenger accommodation will possess some novel features, particularly in respect of size of the saloons and staterooms; the main saloon,



THE CONSTRUCTION OF A 23-KNOT LINER.

The "Deutschland." Length, 686½ feet; beam, 67 feet 4 inches; depth, 44 feet; horse power, 35,000; average sea speed, 23 knots.

DIMENSIONS OF THE LARGEST OCEAN STEAMERS.

Name of Ship.	Date.	Length Over All.	Beam.	Depth.	Draught.	Displacement.	Maximum Speed.
		Feet.	Feet.	Feet.	Feet.	Tons.	Knots.
Great Eastern	1858	692	83	57½	25½	27,000	12
Paris	1888	560	63	42	26½	13,000	20
Teutonic	1890	585	57½	42	26	12,000	20
St. Paul	1895	554	63	42	27	14,000	21
Campania	1893	625	65	41½	28	19,000	22
Kaiser Wilhelm der Grosse	1897	649	66	43	29	20,000	22·35
Oceanic	1899	704	68	49	32½	28,500	20
Deutschland	1900	686½	67½	44	29	22,000	23½

for instance, being capable of seating 500 passengers at one time.

Novel features will be a large playroom for children on the upper deck, and a gymnasium. On the promenade deck there is to be provided a grill room into which a passenger may step and order broiled steak, chops, etc., at a few minutes' notice. It is features such as these that are robbing the transatlantic passage of the romance which was attached to it in the days of our forefathers. We present an illustration showing the "Deutschland" at two different stages of her construction. In one of the cuts the vessel is represented with her keel plate laid and about a dozen of the frames of her flooring forward of the engine space laid in place. The deep wall of the plating which rises from the keel forward of the floor framing marks the position of the engines, where it is necessary to strengthen the frame in order to take the enormous strains of 35,000 horse power which they will develop. In the second illustration the framing and plating of the double bottom is about completed and the frames of the vessel amidship are carried up to their full height. It is expected that the "Deutschland" will make her first trip to this port in April of next year.

As the right of all persons to reasonable use of the highway presumably includes the privilege of leaving carriages at the wayside for temporary purposes, some question has been raised as to the legality of ordinances which prohibit the leaving of bicycles at the curb.

The Origin of Diamonds.

The origin of diamonds is always an interesting question, and Prof. Bonney recently read a paper on the subject before the English Royal Society, which is of considerable importance. In the localities from which the previous supplies of diamonds have been drawn, both in India and Brazil, the gem occurred like a pebble in certain gravelly materials, but had not been traced back to any rock that gave an indication of its genesis. Even after the discovery of diamonds in the river sand on the Orange and Vall Rivers in Southern Africa, they were found in a peculiar material of a brownish-buff color which turned to a dark greenish-bluish tint, and became harder as the miners dug down. The diamonds lay in this material together with several other minerals, such as garnets, iron ores, augite, olivine, etc. Digging was at first begun unsystematically, but from these early efforts the great diamond mining industry was developed. Excavations have been carried on near Kimberley to a depth of more than 1,400 feet. Here the rock is about as hard as ordinary limestone, the blue ground is only found in limited areas. The rocks around are of dark shales banded with hard sandstone in which sheets or dikes of basalt or some material which was once in a molten condition are occasionally found. The blue ground fills a sort of huge shaft in these other rocks, and is itself cut up by similar dikes. Some geologists consider that the gems are produced where they now lie, while others think that they have been formed of some older rock, which has been shattered by volcanic explosions. Many of the minerals associated with it look as if they had been thus derived, and it was sometimes broken. At last it is thought that the mystery has been cleared up. About two years ago the manager of a diamond mine near Kimberley picked up a specimen in which smaller diamonds were apparently embedded in a garnet. His curiosity was at once excited and he proceeded to investigate various bowlders. One of them was broken open and was found to contain diamonds. The rock is one which is known to mineralogists as "eclogite." It appeared to be composed almost exclusively of red garnet rock and a rather peculiar light green augite. The rock is coarsely crystalline and was once, no doubt, like garnet in a molten condition, the diamond being one of its original constituents. This discovery tends to indicate that the "blue ground" in which diamonds were found is not the true birthplace of the diamond. The bowlders are often water-marked and may have reposed for ages in an ancient gravel at the very bottom of sedimentary rocks of the district. Eventually the overlying materials and some of the shattered rocky floor in which the diamonds were embedded, of which these bowlders are only samples, were sent flying by volcanic explosion. It was believed that in this way the diamond-bearing "blue ground" was formed.

The Current Supplement.

The current SUPPLEMENT, No. 1226, has many pages of very unusual interest. "A Few Spiders and Their Spinning Work" is by Miss Mary I. Cunningham and gives illustrations of the spinning apparatus of the spiders and their webs, drawn under the microscope or directly in the field. This is a natural history article of great value and one which we specially recommend. "Liquid Air," by Dr. W. Hampson, describes a new apparatus for liquefying air and contains much valuable information on the subject. "The Metropolitan Underground Railway of Paris" is illustrated by maps and engravings. "Mechanical Influences in Architecture" is concluded in this number and is a most valuable treatise on the subject. "The French at Muscat" describes interesting scenes which occurred to the French while obtaining coaling stations.

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Miscellaneous Inventions.

APPARATUS FOR CATCHING WASTE PRODUCTS FROM LEAD, SILVER, OR OTHER SMELTERS.—WALTER SERGEANT, El Paso, Tex. The apparatus comprises a series of settling-chambers having hopper-shaped bottoms controlled by special devices. The settling-chambers are held in elevated position by standards and are partially separated by alternately-arranged baffle-plates. Transverse air spray-pipes are located between the settling-chambers. A main is connected with the pipes. The waste-products are forced by an exhaust-fan through the trail of the settling. The cold air from the spray-pipes cools the fumes, neutralizes the gases, and precipitates into the hoppers all the metallic substances.

EYEGLASS-GAGE.—LEVI A. STEVENSON, Gaylord, Mich. This invention provides a gage to assist the oculist or optician in securing the exact distance apart and angular position for the nose clamps of eyeglasses, or for the proper spread for the bridges of spectacles. The device consists of a pair of hinged caliper-legs carrying between them slide-gages.

JACK.—GEORGE B. GALLAGHER, St. Mary's, Ohio. This device is an improvement in "oil-well" jacks used in screwing up and unscrewing oil-well-tool joints. The invention provides improved mechanism operating in connection with the pawls of the jack to release the pawls from the track-bar either singly or doubly and independently of the jack handle or lever, and to permit the track-bar to swing so as to conform with the path of the wrench-handle, thus always retaining a straight line of pressure on the traveler and track.

LOCK.—WINFIELD S. HOUSER, Bellefonte, Pa. This knob-lock is a springless lock employing a night-latch. In the lock a locking-latch is hung to move radially through the edge-plate and has an inwardly-curved and upwardly-extending arm terminating in a stop-lug. A gravity-cam has an enlarged weighted end bearing against the curved side of the latch and having a cut-away periphery to receive the stop-lug. A sliding locking-bolt arranged above these parts has a downwardly-projecting arm adapted to come into contact with the top surface of the latch-arm when both bolt and locking-latch are protruded.

CHURN.—MATTIE O'MARROW, Sulphur Springs, Tex. To provide a simple and effective churn-operating mechanism which does not need any particular form of receptacle to hold the cream, is the purpose of this invention. The churn operates so as to aerate and cool the cream while being churned, and to obstruct the centrifugal action by a breaker. The churn is constructed of wood and can be readily repaired by any farmer familiar with the use of wood-working tools.

FRUIT-CLEANER.—JOEL W. HENDRIX, Palmetto, Fla. This machine is especially designed for the cleaning and polishing of oranges, and is composed of two parallel, spiral roller-brushes driven in unison. A series of longitudinal bars is located over the roller-brushes, adjacent to one another to form a casing through which the material cleaned is passed. The bars carry bristles projecting inwardly toward the roller-brushes. When the brushes are rotated, the oranges pass one by one into the casing by the action of the spirally-arranged brushes, being simultaneously cleaned by the bristles previously mentioned.

BLOWPIPE.—MICHAEL P. FREDDY, Lena, Ill. The blowpipe devised by this inventor is particularly adapted for the use of jewelers and dentists, and is so constructed that it may be carried in the pocket. The blowpipe comprises an alcohol lamp adjacent to which a reservoir for alcohol is held. A tube extends from the reservoir and is connected with and surrounded by a jet-tube. Upon igniting the wick of the lamp the jet-tube will be heated, thus causing a vapor to form which will be discharged with great heat.

TAIL-HOLDER FOR HORSES.—GEORGE T. ELKINS, Raus, Tenn. This device consists essentially of an especially-constructed clamp to which a strap is secured. The clamp engages the stump of the horse's tail; and the strap is made to engage the breeching. The device prevents the animal's tail from becoming entangled with the reins.

FENCE STAY.—HARDIN W. DORSETT, Spearville, Kan. The purpose of this invention is to provide means for bracing and staying the running wires of wire fences. To this end the invention embodies a structure formed of integral malleable metal comprising a rolled or tubulated main portion with a notched flange to hold the wires and with a spur and foot at the bottom, the spur serving to enter the ground and the foot bearing thereon to brace the entire structure.

INSULATOR.—JOHN A. CARPENTER, Oxville, and CHARLES F. TONN, Bluffs, Ill. This insulator, for telephone, telegraph, and electric light wires, comprises two sections, from one of which lugs extend which are adapted to be secured to the other section. A wire having been placed between the lugs, a gasket of rubber is arranged on the upper side of the wire and around the lugs, after which the upper section is screwed down. The insulator is designed to obviate the use of tie-wires and of the battery power usually required in charging such tie-wires.

BUST-PAD AND CHEST-PROTECTOR.—MAURICE F. BUCHNER, New Brighton, England. The bust-improver and chest-protector is a light, cool, and easily-adjusted substitute for pads as a means of improving the figure of the wearer and of preventing unsightly creases in the outer garment. The device is also suitable for use as a chest-protector.

TENPIN-BALL.—HENRY G. WILMERLING, Brooklyn, New York city. Tenpin-balls very often check or break at the finger and thumb openings. The inventor of this ball provides the thumb and finger openings with elastic cushions held in place so that they will not interfere with the bowling of the ball and will not check or break no matter how hard they may be brought in contact with a return-rail.

FAUCET.—ENOS W. THAYER, Meredith, N. H. This faucet has a tapering hollow plug, one end of which is open to receive the liquid supply and the other end of which is provided with an orifice adapted to register with the nozzle of the faucet, the plug being so arranged that it can be given slight endwise movement immediately before it is turned, so that friction between the plug and casing is avoided.

TOBACCO-PIPE.—FRANK L. SHUNK, Gold Creek, Mont. The object of the present invention is to provide a means for shielding the flame of a match from wind while lighting the tobacco. The pipe is provided with a shield consisting of two rings of metal, each having a semicircular opening, the two openings being adapted to form a single circular opening when brought in alinement. When the rings have been thus adjusted, a match may be inserted in the circular opening to light the tobacco.

WATER-WHEEL.—RUDOLPH B. KUMMER, Columbus, Neb. This improvement in water-wheels provides a construction which will enable full efficiency to be obtained with any gate-opening. The water-wheel has longitudinally-extending blades or buckets. A cylindrical gate movable longitudinally of the wheel, has a peripheral groove near its lower end. Fitting and rotating in this groove is a partition plate having slots receiving the wheel-blades. A mechanism is provided for raising and lowering the gate.

CLOTHES-RACK.—JOHN F. KOOB, Union, Hudson County, N. J. The clothes-rack is constructed so that when not in use it will occupy a vertical position, and when in use will occupy a horizontal position. When the rack is in a vertical position, its slats will be quite close together, so that but little space is occupied. When raised to a horizontal position the slats automatically spread apart so as to afford a maximum surface for drying purposes. An automatic locking device holds the slats of the rack in a horizontal position. The device may be tripped by a person standing on the floor, no matter at what elevation the rack may be.

GARBAGE-RECEPTACLE AND CLOSET THEREFOR.—CORNELIA S. ROBINSON, Manhattan, New York city. This invention is an improvement on a device patented by the same inventor. The invention provides a casing set in the wall of a building and having a door leading to the room. A fresh-air intake is secured to the apertured bottom of the casing and leads to the outer air. An outlet flue leads from the top of the casing. A receptacle formed at its lower end with an external apertured shell or foot surrounds the opening in the bottom. The receptacle has a cover with an outlet pipe extending into the outlet flue. It will be observed that proper ventilation is provided so as to remove the odors arising from the garbage.

STOKER FOR STRAW-BURNING FURNACES.—HENRY R. NELSON, Gates, Minn. In the bottom of the casing of this mechanical stoker an endless feed-carrier is mounted discharging at one end of the casing. Two sleeves are mounted loosely in bearings at the top of the casing. A shaft is fitted to turn in the sleeves and is turned by gearing in unison with the feeding-carrier. Arms are attached to the sleeves, and a floating feeder-frame is attached to and swings with the arms. A second feeding-carrier is mounted on the floating feeder-frame and is driven by the shaft thereof. The stoker is arranged to feed straw automatically and continuously to the fire-box for immediate consumption.

FLOOR-CLAMP.—EDWIN C. INGERSOLL, Philadelphia, Pa. To provide a floor clamp arranged to enable a carpenter to force a loose floor-board in firm contact with a fixed one, and to nail the loose board in place, is the purpose of the present invention. The frame has a presser-foot and a segmental guideway. A lever is mounted to swing on the frame over the guideway, the lever in turn having a guideway. A jaw slides in the guideway on the lever and has portions engaging the guideway of the frame. The jaws can be held at various positions on the guideway. A stud is carried by the frame and coacts with the jaw.

NON-REFILLABLE BOTTLE.—HENRY WEIL, Manhattan, New York city. This invention seeks to provide a bottle with a valve-mechanism that may be placed and secured in an ordinary bottle-neck, thus permitting a manufacturer to make the bottle in the ordinary mold. The mechanism by means of which it is designed to prevent the refilling of the bottle consists of spring-pressed valves within the neck of the bottle.

MUSIC-LEAF TURNER.—ROBERT HAMMOND, Lake George, N. Y. The music-leaf turner is a mechanical device which may be applied to a piano or like instrument, or to any form of music-rack. The turner is constructed with gripping devices for the leaves, which will not tear the leaves as they are carried from one side to the other. A single trip mechanism is provided through the medium of which the leaf-carriers may be released one after another as rapidly as may be desired. The releasing of one carrier will not in any way interfere with the remaining carriers.

WAGON-BODY RAISER.—SAMUEL N. MAXWELL, Grove, Indian Territory. This inventor has provided a mechanism for the use of farmers whereby a wagon-body may be conveniently lifted off the running gear and held suspended to be again applied to the running-gear when wanted. The body-raiser is of such construction that it may be erected by any farmer simply by using two pulleys and a winding-shaft or windlass, and is arranged for such leverage or power that very little effort is required to perform the work.

TRESTLE.—ARCHIBALD KERR, Carmichael, Penn. The trestle temporarily supports caskets, coffins and the like, so that their inner and outer surfaces may be trimmed. The trestle is provided with a post, on the upper end of which is a union. An L-shaped support has its vertical member connected with the union and has its horizontal member arranged to support the article to be operated upon or trimmed. Angular legs carried by the horizontal member are adapted to rest on the floor.

POOL-TABLE ATTACHMENT.—THOMAS W. GRIFFIN, Milford, Conn. This invention provides a raceway which may be readily applied to any table for the purpose of directing balls from any of the table-pockets into a receiver at one end of the table, thus rendering it unnecessary for a player to collect the balls from the several pockets. The ball-receiver may be raised by lazy tongs from its receiving position nearly to the top plane of the table, so that it is unnecessary to stoop in order to remove the balls.

WINDOW CUPBOARD OR REFRIGERATOR.—VICTOR F. LUTZ, Brooklyn, New York city. It is a general practice in large cities during cool weather to place food outside of upon the window-sill or upon a fire-escape to keep the food cool. The device patented by the inventor is designed to protect victuals thus stored from dust or dirt. The cupboard or refrigerator provided for this purpose is formed of metal sheets flanged together, the end sheets being ribbed to form shelf-supports, and having vertical guide-flanges at their front edges. These front edges are notched at the ribs; and a front plate having flanges embrace the guide flanges and slide thereon.

Designs.

MINER'S CANDLESTICK.—WILLIAM H. PLEASANTS, Victor, Colo. The candlestick has a flat shank, which is to be driven into the rock, and a loop which contains the candle. A rising hooked shank is provided whereby to hang up the candle when it cannot be otherwise supported.

KNIT SLIPPER BLANK.—ERASTUS R. OLMSTEAD, Saratoga Springs, N. Y. The leading feature of the design consists of a ribbed upper portion and a ribbed ankle portion.

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(7681) H. J. T., C. M. W. and others who desire information in regard to the extermination of dandelions and other weeds in lawns. We have referred this matter to the Department of Agriculture, and the followinganswer is given by Lyster H. Dewey, Assistant of the Division of Botany, Department of Agriculture. A. Where perennial weeds, such as dandelion, lance-leaved plantain, and yellow dock, are scattered through lawns, probably the most economical method for destroying them is repeated spudding, that is, cutting them off about two inches below the surface of the ground with a spud. Spuds may be obtained from hardware dealers, or a cheap and efficient spud may be made by mounting a one inch chisel in a hoe handle. Another method for destroying weeds of this character is to treat them with crude carbolic or sulphuric acid, the acid being applied with a machine oil can with a spout about 2½ inches long so that the operator does not have to stoop to place the acid in the middle of the rosette of leaves. About 5 drops of crude sulphuric acid or a half a teaspoonful of crude carbolic acid will be sufficient to kill a dandelion or plantain. Where the soil is not alkaline the dose can probably be made smaller than this. For annual plants such as peppergrass, speedwell, chickweed, and shepherd's purse, there is no satisfactory remedy except pulling them up or hoeing them out, putting in new seed or sod. Care should be taken to prevent annual weeds from going to seed in and around lawns. In all cases where weeds are removed by any method, efforts should be made to encourage the growth of grass so as to prevent the further growth of weeds. The land should be kept enriched and seeds sown in all bare places. Extreme care should be exercised to have the lawn grass seed free from weed seeds. It is generally best to sow only one kind of lawn grass, as the mixed lawn grass seeds are much more likely to contain weed seeds. Furthermore a lawn composed entirely of one kind of grass makes a much prettier sward than one composed of several kinds.

(7682) F. J. H. writes: I understand that the atomic particles of a gas tend to get away from each other. What bearing has this on the definition and universality of the law of gravitation? A. Your conception that "atomic particles try to get away from each other" is somewhat at fault. They have no inherent tendency to do so. The tendency is an impressed tendency, and heat is the cause of the tendency. The hypothesis is that the particles of a gas are in constant motion and are colliding with each other, after which they rebound and move away in another line till they strike a second particle or the wall of the containing vessel, etc., ad infin. Take away all heat, and this motion would cease. No connection between this and gravitation has been shown.

(7683) M. N. W. asks: In telephonic communication is it the machine and not the actual voice that is heard? Or is it not the voice itself that is heard through the medium of the machine? A. In telephonic communication, the sound waves produced by the voice of the speaker cause the diaphragm of the transmitter to vibrate. These vibrations have the same period as the waves of the voice. The vibrations of the diaphragm cause the electric current through the line to vary in the same periods. The variation of the electric current sets the diaphragm of the receiver into vibration, and this vibration is received by the ear of the listener as sound. The voice is not transmitted. A current of electricity is transmitted through the line. A voice could not be heard from Chicago to New York. It is, however, very wonderful that the vibrations of the diaphragm of the receiver reproduce the qualities of the voice of the person speaking so perfectly that the person can be recognized by the reproduced tones.

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NOTICE SUR LE PROCÉDÉ DE M. CHARLES JANET POUR SE RENDRE INSUBMERSIBLE EN MER. Beauvais. Author's Edition. 1898.

ETUDES SUR LES FOURMIS, LES GUÊPES ET LES ABEILLES. Note 13. Sur le Lasius Mixtus, l'Antennophorus Uhlmanni, etc. Limoges. 1897.

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